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SIT-DL-81-9-2137. Final Report.
March 81

DOCUMENT IDENTIFICATION

Contract N00014-79-C-0914

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DAVIDSON LABORATORY

Report 2137
March 1981

PERFORMANCE AND SEAKEEPING TESTS AND ANALYSIS OF A STRUCTURAL LOADS MODEL OF A L/B=6 BUOYANT SIDEWALL SES

by

P. Ward Brown, Gerard Fridsma

and

Walter E. Klosinski

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REPORT DOCUMENTATION PAGE

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1. REPORT NUMBER SIT-DL-81-9-2137	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) PERFORMANCE AND SEAKEEPING TESTS AND ANALYSIS OF A STRUCTURAL LOADS MODEL OF A L/B=6 BUOYANT SIDEWALL SES		5. TYPE OF REPORT & PERIOD COVERED Final September 1979-March 1981 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) P. Ward Brown, Gerard Fridsma and Walter E. Klosinski		8. CONTRACT OR GRANT NUMBER(s) N00014-79-C-0914
9. PERFORMING ORGANIZATION NAME AND ADDRESS Davidson Laboratory Stevens Institute of Technology Hoboken, NJ 07030		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS Surface Effect Ships Project Office, PMS-304 P.O. Box 34401 Washington, DC 20034		12. REPORT DATE March 1981 13. NUMBER OF PAGES
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office) Office of Naval Research 800 N. Quincy Street Arlington, VA 22217		15. SECURITY CLASS. (of this report) UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

APPROVED FOR PUBLIC RELEASE: DISTRIBUTION UNLIMITED

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Surface Effect Ships
Slamming
Seakeeping
High Speed Marine Vehicles
Structural Loads

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Smooth and rough water performance data in the off cushion mode were obtained on a buoyant sidewall SES model over a range of displacements, LCG's, speeds, and sea states. The segmented model was instrumented to measure shear and bending moment at two longitudinal cuts. Loads data in regular waves and in irregular waves of high severity were obtained. Results, together with an analysis of the data, are discussed.

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

STEVENS INSTITUTE OF TECHNOLOGY
DAVIDSON LABORATORY
CASTLE POINT STATION
HOBOKEN, NEW JERSEY

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Prepared for

Surface Effect Ships Project Office

under

Contract N00014-79-C-0914
(Davidson Laboratory Project 4768/073)

Approved: ______________________

Daniel Savitsky
Deputy Director

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INTRODUCTION

The development of the SES has been motivated by the potential advantages of a high-speed ocean-going warship that could be realized by the SES concept. Nonetheless, the low-speed hull-borne operation of SES must be considered in order to extend their range, to reduce loads and motions in heavy seas, and to ensure adequate performance in the event of a loss of cushion power. Studies by the SES Project Office of the structural loads arising in hull-borne operation have lead to the conclusion that the slamming loads due to the impact of the bow ramp with oncoming waves are a major factor in the structural design of SES. In order to minimize the loads due to ramp and wetdeck slamming the concept of the buoyant sidewall SES has evolved.

SES technology has been mainly concerned with the thin sidehull SES operating on-cushion, and therefore with essentially non-buoyant sidewall craft. In this report the performance of a specific L/B=6 buoyant sidewall SES, in calm water and in waves, is presented and discussed. A special segmented model was used, with two transverse cuts approximately 25% of the length from the bow and stern, instrumented to measure the longitudinal shear and bending moment.

The tests were conducted in Davidson Laboratory's Tank No. 3 during the period of July through September 1980. Representatives from the Surface Effect Ships Project Office (SESPO), David W. Taylor Naval Ship Research and Development Center (NSRDC), and Hydromechanics, Inc., were on site at various times to observe the test series.

MODEL

Length-Beam Ratio

It is convenient to refer to various SES designs in terms of their length-beam ratio for the purposes of identification. The length-beam ratio of an SES is computed from the length and beam of the cushion footprint. In testing buoyant sidewall SES in the off-cushion mode it is not necessary to define the extent of the cushion, and hence the length-beam ratio is not apparent. From a brief review of SES designs it appears that their L/B ratio can be defined in terms of the cushion beam, wetdeck height, and overall length:

$$L/B = (LOA - 2.5H)/B$$

where LOA = overall length

H = wetdeck height above keel

B = beam between sidewall at keel, in the midship section.

For the model used in these tests (see Figure 2):

$$L/B = (84.8 - 2.5 \times 6.17)/12.168$$

$$= 5.7$$

$$\therefore \quad L/B = 6 \text{ approximately}$$

Configuration

The general proportions of the L/B=6 buoyant sidewall SES were selected by PMS-304, to be suitable for a 500 ton ship. A lines drawing was prepared to SESPO specifications and submitted for approval. Requested modifications were incorporated in the original lines drawings, and a revision was submitted and approved, (Davidson Laboratory Drawing No. 4768/073/8004-00).

It was the intention of PMS-304 that the model be used to represent both a 700 ton and 15,000 ton ship at model scales of 30 and 83 respectively. Therefore to facilitate general use of the data all results are given model scale. Model particulars are given in Table 1 and the lines of the model are shown on Figures 1 and 2. Photographs of the model under tests are included on Figure 6.

Model Construction

The buoyant sidewall model was designed and built at the Davidson Laboratory to permit the measurement of the bending moment and shear force at two stations, as well as the usual tasks of collecting performance and seakeeping data. In making measurements of dynamic impact loads the natural period of the measuring system must not exceed the rise time of the impact pulse. Otherwise the incoming force will be distorted in magnitude and phase. Since previous attempts to measure dynamic bending moments have been impaired by a too low fundamental frequency in bending,[1] it was necessary to select a sufficiently high natural frequency for this model. In consultation with PMS-304 a design value of 50 Hz was selected. On the model, therefore, an impact whose rise time exceeds at least 0.02 seconds would be recorded quite well. Assuming a scale ratio of 1/30 this would correspond to a full-scale rise time of 0.1 seconds or more. Shorter pulses, having a model rise time of 5 to 15 milliseconds, would be magnified by about 30%, and the model would be relatively insensitive to impacts with a rise time of less than 2 milliseconds.

The main structure of the model consisted of a marine plywood deck, extending the full length and width of the model, with marine plywood keelsons for the full depth of the sidewalls as shown on Figure 2. Transverse bulkheads were built into the sidehulls, fore and aft of each transverse cut, shown on Figure 1. The model was built in one piece with spacers in the bulkheads, these were later removed and the deck cut transversely as a last step in the model construction. Blocks of polyurethane foam, density 4 lb/cu.ft, were glued to the plywood backbone and worked to the required contours. A view of the underside of the model at this stage in the construction is shown on Figure 3. An aluminum support frame was fastened to the deck of the model as shown in Figure 4. This frame, in addition to contributing to the bending stiffness of the model, provided the attachments for the shear force and bending moment springs. These necked-down cantilever springs may be seen in Figure 4. The fore and aft springs on the starboard side were strain-gaged to permit the measurement of shear force and bending moment on the bow and stern modules. The plexiglass bow ramp is also visible on Figure 4, this adjustable ramp extends 7.6 inches aft of the bow (see Figure 1) and was fixed at 15 degrees for all the tests.

After fitting the aluminum frame to the model, it was removed from the deck, the spacers were removed from the bulkhead, and the deck was cut traversely separating the model into three sections consisting of bow module, centerbody and stern module. These components were fiberglassed and finished with primer and three coats of acryllic lacquer. The model was then assembled and the natural frequency in bending determined to be about 30 Hz. In order to increase this frequency, four changes were made to the model:

* The depth of the measuring springs was increased from 0.5 to 1.0 inches.
* The depth of the aluminum frame was increased from 1.25 to 2.5 inches, as shown on Figure 2.
* The thickness of the plexiglass bow ramp was reduced from 0.25 to 0.125 inches.

* The spring attachment pads on the bow module originally relied on the plywood deck for their fixing, see Figure 4. Longitudinal structural members were added to the bow module, tying the pads to the transverse members fore and aft of the bow module.

These changes raised the lowest natural frequency to 49.2 Hz, which was accepted.

To assist in the interpretation of the overwater and underwater photographs the model was gridded with waterlines parallel to the keel at 0.8 inch pitch, and with station lines every 3 inches from the transom. The transparent bow ramp was painted with a 2 inch square grid starting at the knuckle and symmetrical about the model centerline.

This model was tested during July and August, 1980, and was designated Configuration 1. During these tests prows were added to the sidewalls which extended 8 inches forward of the knuckle, were 4.5 inches high and overhung the sidewall by 0.25 inches, (see Figure 5 lower picture). These prows were used as a breakwater to keep water off the deck during testing.

As a result of these first tests it was decided in conjunction with PMS-304 to modify the model to achieve Configuration 2 by the following changes:

* Removal of 75 cubic inches from the stern of both hulls to achieve a level trim with an LCG at 46% LBP. This volume extends 14 inches forward of the transom, up to the 3.2 inch water line, and 1.68 inches into the sidehull, see Figure 2.

* Addition of a 0.25 inch square spray rail at the chines of the model extending 16 inches aft of the stem.

The results of these modifications to the model are shown on Figure 5. A 7 inch breakwater was added to the bow to protect the instrumentation from water on the deck.

Model particulars are given in Table 1 and pictures of the model under test are included on Figure 6.

During construction a note was made of the location and weight of each element of the model, and estimates were made of the weights of fiberglass, epoxy and paint. This information was used to prepare a table of mass distribution, as has been done in Table 2.

APPARATUS AND INSTRUMENTATION

Model Instrumentation

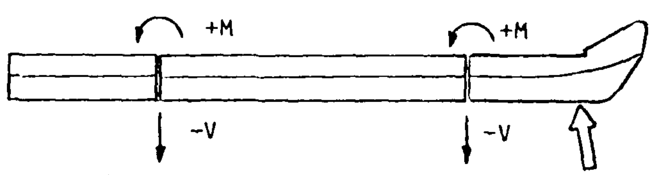
The buoyant sidewall model was equipped with a trim inclinometer, accelerometers, and strain gages to measure the shear forces and bending moments on the bow and stern modules.

The trim inclinometer was mounted just aft of the pivot box to monitor the static trim.

Four accelerometers, two at the fore and aft ends of the bow module and two at the fore and aft ends of the centerbody, were mounted in the model at the locations indicated in Figure 1 and summarized in Table 1. These were of the strain gage type with a natural frequency of 700 Hz, a damping of 0.7 critical and a range of 15 g.

Pairs of strain gages were cemented to the top and bottom of the aluminum springs and aluminum tubing as indicated on Figure 1, and connected as full bridges at each location. The outputs from the two forward bridges were combined to obtain signals proportional to the shear force and bending moment at the forward cut, and similarly for the aft cut. Compensating circuits were included in the strain gage networks to adjust signal levels and to ensure that the shear force was independent of bending moment. In addition, shunt resistors were installed to provide known calibration signals equal to approximately half of the expected maximum values.

Calibrations were conducted with the centerbody supported upside down on a surface table and the bow and stern modules cantilevered off the ends. Combinations of vertical loads and pitch bending moments were applied to each module separately. The positive sense of the forces and moments is defined by the following sketch:



An upward load on the stern module produces a positive shear force and a positive bending moment at the forward and aft cuts. Conversely, upward loads on the bow module produce negative shear and positive bending at both cuts. The calibrations were found to be linear and free of cross-talk.

Facility Instrumentation

A standard free-to-heave apparatus was coupled to the model through a drag balance and pivot box whose pitch axis was located 42.18 inches forward of the transom and 8.1 inches above the keel in the Configuration 1 tests, and 8.3 inches above the keel for Configuration 2. While allowing the model heave and pitch freedom, the apparatus fixed the craft in roll, sway and yaw. The pivot box included a remotely controlled trim-lock for making fixed trim tests. Heave and pitch transducers were provided to measure the motions of the pitch axis. In addition a heave transducer was included to measure the height of the knuckle above the smooth water surface. This latter quantity was obtained by attaching a light line at the knuckle and centerline of the model. This line proceeded vertically upwards, around a transducer pulley, and to a 6 ounce constant force spring. The effect of the small amount of unloading was counter-balanced by an equal amount of weight taped to the deck. A moving wave wire mounted abreast of the bow module knuckle and 3 feet off the port sidewall measured the wave profile. A photograph of the experimental setup is included as Figure 6.

The segmented model proved to be overweight due to the structure used to achieve the high natural frequency needed to validate the computer simulation. The test weight of 56 lb was achieved by an unloading force of 40 lb, provided by a counter-balance in calm water and by constant force springs in waves. The effect of the excess mass on the model response in irregular waves has not been determined.

The thirteen transducer signals were relayed through overhead cables to the data station on shore where they were recorded on analog magnetic tape and on a direct writing oscillograph. The signals were low-pass filtered to 40 Hz. They were then passed to the on-line PDP-8e computer for appropriate processing.

Photography

A camera carriage was mounted ahead of and to port of the model bow for a television camera, so that the model behavior could be observed on a remote monitor. All the runs were video-taped in color and are on file at the Davidson Laboratory.

A high speed camera was mounted on the carriage above the bow ramp. The scene was illuminated from below by means of a carriage mounted spot light shining on the bottom of the tank Color motion pictures were taken at 160 frames/second looking through the transparent bow ramp. This system of back-lighting provided good definition of the ramp-waterline intersection.

Underwater still photographs were taken of each run in calm water and in regular waves. These photographs provide for the determination of hull wetting and for the estimation of hydrostatic or buoyancy forces in waves, e.g. Figure 22.

Wavemaker

The Tank 3 plunger type wavemaker, located at the far end of the tank, was used to generate the required regular and irregular waves. Waves having nominal heights of 4 and 6 inches with periods of 1.2, 1.35 and 1.5 seconds were used. These waves have been shown to be pure sine waves by harmonic analysis.[1] The irregular waves consist of a quasi-random reproducible set of 100 waves having variance densitites approximating the Pierson-Moskowitz spectra. The experimental spectra of the five wave trains generated (significant heights of 1, 1.8, 2.75, 4.1, 6.1 and 7.5 inches) are shown on Figures 7, 8 and 9. These spectra were measured by a stationary wave-wire. A moving wave strut was rigged ahead of and to port of the model to monitor the wave encounters.

DATA REDUCTION

Calibrations of the instrumentation were made by applying known loads and moments to the load cells, gravity multiples to the accelerometers, and known displacements to the motion and wave elevation transducers. During calibration, the outputs from the transducers were fed to the PDP-8e computer. All calibrations were linear and straight lines were fitted to these data by the least-squares technique. Calibration signals based on the computer rates were used for all data channels.

Data channels were scanned by the PDP-8e computer at the rate of 250 Hz and stored in the computer for appropriate processing. Test results were determined from the differences between transducer outputs in the running and static floating condition. Velocities were computed from the time taken to travel through the data trap, which was 50 ft long for calm water tests, and 150 ft for wave tests.

Processing of the calm water data resulted in the mean values for the drag, draft and trim. For the wave tests, a peak-trough analysis was carried out of the pitch and heave motions, of the wave elevation abreast of the bow ramp knuckle and of the elevation of the knuckle. In addition, the shear and bending moments at the two cuts were analyzed as were the signals from the four accelerometers. The peak-trough analysis computes for each signal the mean and rms, the number of oscillations, the average of the peaks and trough, the average of the 1/3-highest and the 1/10-highest peaks and troughs and the extreme values of the peaks and troughs. Typical buffers employed in these tests were 0.25 degrees in pitch, 0.1 inch in vertical elevation, 1.0 lb in shear, 1.0 ft-lb in bending moment and 0.2 g in acceleration. Oscillations smaller than these riding on the backs of larger waves in the individual time histories were neglected.

TEST PROGRAM

Configuration 1

Tests in calm water were conducted to study the performance of the original design for the L/B=6 buoyant sidewall SES model, and to determine the optimum trim. In describing the test conditions a model scale of 1/30 is assumed, although all test results are given model size. Thus the calm water test parameters correspond to the following full-scale conditions:

Load, long tons	700, 955
LCG, percent LBP	39, 41.5, 44, 48, 50
Speed, knots	4, 8, 12, 14, 15, 16, 20, 24, 28

At the design LCG of 50%, Configuration 1 ran at a negative trim of from -1.5 to -2.0 degrees with considerable deck wetness. Therefore a prow was added to each sidewall, incorporating a spray deflector at the deck to allow the tests to continue.

At 14 knots the drag was practically insensitive to trim across the range of ±1 degree.

The tests in irregular head seas representing Sea States 2, 3 and 4 (significant wave heights of 2.5, 4.6 and 6.9 ft) were made in 4 knot increments at speeds corresponding to 4 to 28 knots. The two loading conditions for these wave tests were selected by PMS-304:

	(1)	(2)
Load, tons	700	955
LCG, percent LBP	41.5	47.6
Trim at 14 knots, degrees	0.3	-0.5

Configuration 2

The modified configuration with volume removed from the afterbody of the sidewalls was again tested in calm water to locate the optimum trim at 14 knots. Tests were run at the following equivalent conditions for a 1/30-scale:

Load, long tons	450, 955
LCG, percent LBP	43.7, 45.7, 47.7, 49.7, 51.7
Speed, knots	14

As a result of this survey an LCG of 47.7% LBP was selected and calm water tests were run over the speed range up to 28 knots:

Load, long tons	450, 700, 955
LCG, percent LBP	47.7
Speed, knots	4(4)28

Calm water tests were also run with the model fixed in both trim and heave, in order to provide data on the high-speed drag of buoyant sidewalls at the small drafts relevant to cushion-borne operation. The draft at midships was fixed at two values corresponding to 2 ft and 4 ft full size. Three values of trim were used: 0 and ±0.5 degrees. Test speeds correspond to 20, 30, 40, 50 and 60 knots.

The modified L/B=6 buoyant sidewall model was run in regular head waves at a load corresponding to 700 tons with the LCG at 47.7%. Tests were made at speeds equivalant to 4 and 8 knots:

Speed, knots	4		8		
Wave length, ft	220	280	220	280	340
Wave height, ft	15	15	10	10	15

These conditions were expected to result in bow ramp slamming, so motion pictures were taken of the bow ramp during these runs. For these tests the underwater pictures were synchronized with the data record and the motion pictures.

Irregular head sea tests were made at loads of 700 and 955 tons with the LCG at 47.7%. Waves of greater severity were used in these tests of the modified model corresponding to Sea States 5, 6 and 6+. These tests were repeated throughout the wave train to obtain the maximum sample for statistical analysis of the shear and bending moment. Test conditions were:

	700		955	
Load, long tons	700		955	
Speed, knots	4	8	4	8
Significant wave height, ft	19	15	19	15

PROCEDURE

Shear Force and Bending Moment Zeros

Shear force and bending moment zeros were taken before each run with the model floating dead in the water, at the load and LCG to be tested. Therefore the shear and bending are measured from the floating condition and if total forces and moments are required the static values must be added in. These static floating values may be calculated from the floatation waterlines (see Tables 3 and 4).

It is considered that this method of reporting shear forces and bending moments as increments with respect to the floating conditions is appropriate for model tests. This does not imply that the floating forces and moments are negligible, they are in fact very significant. These forces and moments, however, depend on the difference between the buoyancy forces on each segment of the model and the weight of each segment. Since the weight distribution in the model cannot be the same as the ship, the floating shear force and bending moment distribution for the model is not representative of the ship. Therefore to obtain total forces and moments it is necessary to combine the floatation buoyancy, derived from the model waterline, with the ship weight distribution.

The contributions to the model shear and bending in the reference floating condition are given in the following table for Configuration 2 at two test weights, with the LCG 40.44 inches ahead of the transom.

TABLE OF FLOATING
SHEAR FORCE AND BENDING MOMENT
Configuration 2

	Due to Model Weight	Due to Buoyancy	Total
	Load 56.14 lb, LCG 40.44 in		
Shear Force, lb			
At aft cut	-15.6	13.4	-2.2
At forward cut	-36.0	43.8	7.8
Bending Moment, ft-lb			
At aft cut	-12.9	10.3	-2.6
At forward cut	-109.9	101.7	-8.2
	Load 77.14 lb, LCG 40.44 in		
Shear Force, lb			
At aft cut	-15.6	18.2	2.6
At forward cut	-57.1	61.8	4.7
Bending Moment, ft-lb			
At aft cut	-12.9	14.4	1.5
At forward cut	-144.5	145.3	0.8

Air Tares

The model was towed in the air at zero trim up to a speed of 18 fps. It was determined that the air drag varied as the square of the speed:

$$D_{air} = 0.00068V^2$$

and was practically negligible, i.e. less than 0.1 lb for speeds less than 12 fps, and was not removed from the data. The aerodynamic drag coefficient based on total frontal area was:

$$C_D = 0.4$$

Dynamic Shear and Bending

Before the tank tests began, a vibrator was mounted on the bow module and a sinusoidally varying vertical point load applied to the bow over a range of frequencies from 10 to 36 Hz, and for amplitudes of 10 to 36 lb. A comparison of the measured bending moment and shear force with those applied showed that the dynamic measurements were within ±10%.

PRECISION

The precision of the test measurements may generally be expected to fall within the following model-scale values:

Trim Inclinometer	± .05 degrees
Pitch Motion	± .15 degrees
Heave Motions	± .05 inches
Accelerations	± .05 g
Wave Height	± .25 inches
Drag	± .10 lb
Velocity	± .01 fps
Shear	± .50 lb
Bending Moment	± .50 ft-lb

RESULTS

Calm Water

The results of the tests in calm water are given in model scale in Tables 3 and 4 for Configurations 1 and 2 respectively. It should be noted that these tables also contain the zero speed static floatation data for a wide range of conditions. The fixed trim and heave results for Configuration 2 are given in Table 5. The underwater photographs showing sidewall wetting were printed in an 8" x 10" format and a complete set delivered to PMS-304.

Graphical presentations of some of the calm water data is contained in Figures 10 to 14.

Regular Waves

The results obtained in regular waves with Configuration 2, at 56.14 lb displacement and 40.44 inches LCG, are given in Table 6. The speed and regular wave parameters for each run are given at the head of the table followed by the statistics of the response. During each cycle of wave encounter, the shear force, bending moment and acceleration time histories show a triangular pulse as the bow ramp slams into the waves (e.g. Figure 19b). The amplitude of this pulse was averaged for 10 cycles and is given in the table as the "Avg. Maximum". The Bow Accelerations #1 and #2 refer respectively to the acceleration of the bow module at 7.6 inches aft of the stem and at the forward cut. The accelerations of the centerbody at the forward and aft cuts are given as CG Accelerations #1 and #2.

The shear forces and bending moments are given relative to the static floating condition for 56.14 lb load and 40.44 inch LCG.

It may be remarked that the last entry for the wave elevation does not show a zero mean, which is unusual for waves. This is as a result of measuring the wave in the vicinity of the model abreast of the forward cut. Evidently at a speed of 2.4 fps the model generates a bow wave having an elevation of 0.4 inches at the wave transuducer; this bow wave is clearly smaller at lower speeds. However the RMS wave elevation in the vicinity of the hull still corresponds to the incident wave height (i.e. wave height = 2.83 RMS), therefore the effect of the hull at the transducer appears to be confined to raising the mean level in regular waves.

The underwater photograph taken during Run 262, and shown on Figure 22. was analyzed to obtain the instantaneous draft in regular waves at each of the station lines which are spaced at 3 inch pitch. These readings were used to estimate the submerged sectional areas, the weight of water displaced by the sidewalls and the moment about the transom. These results are included in Table 7 and are used in subsequent shear and bending analysis of Run 262.

Irregular Waves

The peak-trough statistics obtained with the original L/B=6 buoyant sidewall SES model in irregular headseas are given in Table 8. The listings, one run to a page, are preceded by a Run Directory for the 30 runs covering a range of conditions up to a significant wave height of 2.75 inches at 8.64 fps.

The results for Configuration 2 are given in Table 9 in a similar manner, preceded by a Run Directory of the 5 runs in large seas up to 7.5 inches significant height.

Occasional blanks in these tables are due either to there being too few oscillations to warrant the calculation of the 1/3 and 1/10 statistics or to signal drop-out from a transducer.

ANALYSIS AND DISCUSSION

Calm Water Performance

The effect of the trim on the calm water drag of Configuration 1 at 4.63 fps (corresponding to 15 knots for 1/30-scale) is shown to be small on Figure 10. The plot of LCG position shows that the ship would run at -1.5 degrees with a design LCG of 50% LBP. At 77.14 lb the optimum LCG for Configuration 1 is 47.5% LBP, however, the drag is essentially insensitive to trim.

The drag-weight ratio as a function of Froude Number (Fn based on LBP) is shown on Figure 11 for two weights and CG's. This ratio is independent of load in the range shown (corresponding to 700 to 1000 tons) and practically independent of CG positions up to Fn = 0.4 (20 knots).

The optimum trim for Configuration 2 is -0.4 degrees at 4.32 fps (14 knots) as shown on Figure 12. At both 36.35 and 77.14 lb the optimum LCG for Configuration 2 is 47.5% LBP. The drag-weight ratio at this CG is shown on Figure 13 as a function of Froude Number. Up to Fn = 0.45 the drag of Configuration 2 is the same as that of Configuration 1. At higher hull-borne speeds Configuration 2 has about 15% more drag than Configuration 1; this might be corrected by optimizing the trim at high speed (30 knots) rather than at low speed where the sensitivity to trim is small.

Drag at Fixed Trim and Heave

The sidewall drag at drafts and trims typical of cushion-borne operation is shown in the form of a drag coefficient over the speed range on Figure 14. This drag coefficient is based on a nominal wetted area equal to the product of midship girth and the waterline length. At a draft of 0.8 inches an area of 2.51 sq. ft. is used, at 1.6 inches draft the area is taken to be 4.83 sq. ft. The observed drag is approximately equal to twice the skin friction drag.

Seakeeping and Performance in Irregular Waves
Configuration 1, Sea States 2, 3 and 4

The pitch and acceleration characteristics for a 700 ton hull-borne SES in head seas are shown on Figure 15. The pitching motion reaches a maximum response at 12 knots and diminishes slightly at higher speed. The extreme double amplitude in pitch is proportional to the RMS pitch with a factor of 5.5;

thus in Sea State 4 an extreme double amplitude of 8 degrees ($\pm 4^{o}$) might be expected.

The accelerations seem to level off above 16 knots, generally showing a linear increase with sea state. The extreme peak acceleration is equal to five times the RMS acceleration. At heavier loads the accelerations are reduced, being inversely proportional to the displacement. So that for 955 tons a peak acceleration of 0.75 g would be predicted at 16 knots in Sea State 4. Since the accelerations amidship will be half those at the bow, it appears that the SES will be exposed to modest accelerations within the operational envelope of speed and the sea state specified by PMS-304.

The added resistance in waves is shown on Figure 16 for two speeds and both weights. The increments are small and hence rather scattered. The available data shows a linear trend with significant wave height.

The irregular wave tests of Configuration 2 were conducted in large waves to determine structural loads and are discussed later. It is expected that the seakeeping behavior of the two models will be very similar.

Response in Regular Waves

The tests in regular waves were carried out at conditions expected to result in ramp slamming, in order to provide data for validating computer modelling of SES slamming in waves. To this end the time histories of the data channels were digitized at 250 Hz for approximately ten wave encounter cycles, and stored on digital magnetic tape. This digitized data was then used to generate the graphical presentations on Figures 17 to 21, one figure per run, of Runs 260 to 264.

Each of these figures consists of three parts. For example, consider Run 262 on Figure 19: the motion time history is shown on Figure 19a, the shear force, bending moment and bow acceleration is shown on Figure 19b, and a detail of Figure 19b is shown on Figure 19c covering the slam event from start to maximum on an expanded time scale. The motion time histories (e.g. Figure 19a) show one cycle of pitch motion starting from the instant when the pitch is zero and decreasing. Below this is the height of the tow point above the mean water level. The next time history shows the wave elevation abreast of the knuckle and 3 feet off the port sidewall; this location was chosen to avoid spray and wavelets originating at the model, however this wave record is affected by the presence of the model. The bottom time history shows the distance of the bow ramp knuckle below the surface of the wave (projected on the centerline) measured 3 feet off the port sidewall, and is indicative of the knuckle wetting.

The time histories of the forces and moments at the forward cut (e.g. Figure 19b) together with the acceleration at the knuckle are shown for one cycle of pitch. In Run 262 it can be seen that these quantities have a sinusoidal variation, approximately in phase with the knuckle draft, with a slam event occuring 200 milliseconds after the start of the cycle. The expansion of the time scale up to the instant of the bending moment maximum shows that the rise time of the slam is of the order to 50 milliseconds. The shear force peaks slightly earlier, suggesting that the center of pressure is traveling forward so rapidly that the bending moment continues to grow despite a slight reduction in the shear force.

The slam on the bow ramp seems to occur when the knuckle meets the flank of the oncoming wave. Under these conditions it has been conjectured that the ramp wetting starts at the knuckle and that the intersection of the ramp with the wave is a straight line, parallel to the knuckle, which moves forward as the slam progresses. The high speed motion pictures of the ramp during the regular wave tests show that while this pattern of ramp wetting sometimes happens, it usually does not despite the high quality of the incident waves.[1] Sometimes wetting starts at the port side of the ramp moving laterally to starboard, and in the same run water contact may start on the starboard side and move to port. Sometimes wetting starts in the center of the ramp. The leading edge of the wetted area is very seldom a straight line, although this configuration was sometimes seen during Run 262 when the apparent speed of this line was estimated to be 8.24 fps along the ramp. It is concluded that the waves radiated from the sidewalls have a significant effect on the wetting of the bow ramp.

It should be noted that the shear force axis is reversed because one tends to assume that a slam on the bow produces upward positive shear. However the convention used during these tests (see Page 5) and the ensuing calculations assumes that an upward force at the bow produces negative shear at the two cuts.

Analysis of Instantaneous Shear Force and Bending Moment in Regular Wave Run 262

During the tests with Configuration 2 in regular waves, underwater pictures were taken of the model in order to provide a means of analyzing the instantaneous shear force and bending moment. An attempt was made to synchronize the underwater photograph with the peak bending moment during the slam. Out of the five regular wave runs, Run 262 came the closest to synchronizing the photograph with the peak moment and was therefore chosen for analysis.

Run 262 was made at a speed of 1.23 fps into regular waves 6.1 inches in height with a period of 1.35 seconds and a length of 9.3 ft. From synchronization marks in the time history it was determined that the underwater flash picture was taken 0.41 seconds after time zero, see Figure 19, and therefore 0.21 seconds after the bending moment maximum. This picture, Figure 22, was then analyzed to determine the variation in height of water above the keel on the outboard side of the starboard sidewall. The hydrodynamic force was then calculated at every station along the hull by a method used by PMS-304 which assumes that the water pressure is due to the local hydrostatic head above the keel. The calculation of the resulting hydrodynamic forces and moments is shown on Table 7. The buoyant force is transferred to Table 8 for the calculation of the shear force and bending moment distributions. The weight distribution from Table 2 is also repeated in Table 8. The weight and buoyant force distribution are plotted on Figure 23.

At the instant of the flash picture the four accelerations are read from the time history and plotted against their longitudinal location as shown on Figure 23. As may be seen the instantaneous acceleration varies linearly along the hull and the fitted equation may be used to calculate the vertical acceleration throughout the hull as has been done in Table 8.

Other quantities read from the time histories at 0.41 seconds include:

Pitch, degrees	4.4
Height of tow point, in.	3.7
Wave elevation, in.	0.9
Apparent knuckle draft, in.	2.0

In addition the shear forces and bending moments at the fore and aft cuts were determined from smoothed time histories. The forces and moments shown on

Figure 19 are relative to the floating zero and to obtain absolute values the zeros given on Page 11 must be included. Since for Run 262 the model weight was 56.14 lb with the LCG at 40.44 inches the following relative and absolute values are obtained:

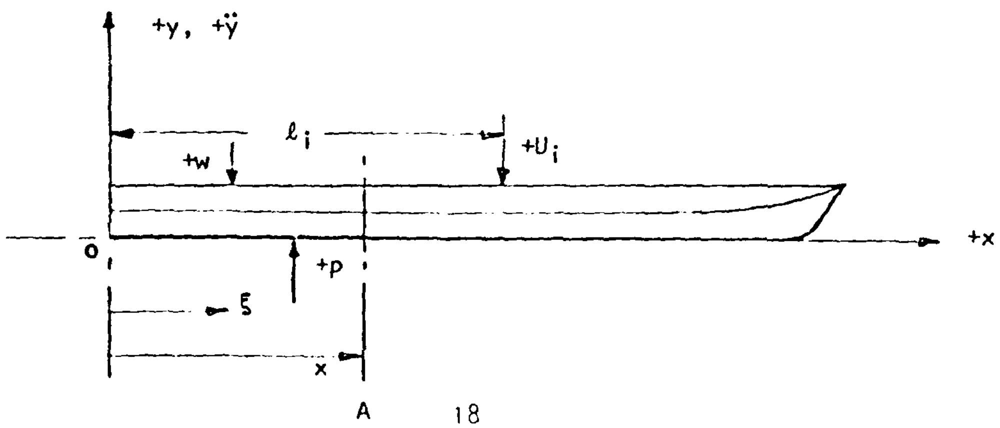
TABLE OF INSTANTANEOUS
SHEAR AND BENDING, RUN 262

	Relative Values (Fig. 19)	Absolute Values	Calculated Values
Shear Force, lb			
At aft cut	3.6	1.4	-0.5
At forward cut	-4.6	3.2	4.4
Bending Moment, ft-lb			
At aft cut	3.2	0.6	-0.8
At forward cut	2.6	-5.6	-4.8

The calculation of the instantaneous shear and bending is the next topic of discussion.

Calculation of Shear Force and Bending Moment

The external forces acting on the L/B=6 SES are the gravity forces, both concentrated and distributed, and the hydrodynamic forces. In general these forces are not in equilibrium and the SES is therefore subject to rigid body accelerations. All these quantities are known at the instant the picture on Figure 22 was taken: the gravity forces and accelerations from measurement, and the hydrodynamic pressure by assumption based on the observed draft. We may therefore calculate the vertical force acting throughout the hull by using D'Alembert's Principle to reduce this dynamic problem to a statical one.



The schematic representation of the SES hull shows the axis system used in the analysis, with origin at the transom, the forces acting on the SES and their sense. The external forces include the distributed weight $w(\xi)$, a number of point forces U_i at ℓ_i, and the distributed hydrodynamic force $p(\xi)$; the reversed effective D'Alembert force is $-m\ddot{y}(\xi)$ where $m = w(\xi)/g$. The net upward positive vertical force on any section that does not include a point load, is:

$$f(\xi) = p(\xi) - w(\xi) - \frac{w}{g}\ddot{y}(\xi)$$

$$\therefore \quad f(\xi) = p(\xi) - w(\xi)\left[1 + \frac{\ddot{y}(\xi)}{g}\right] \qquad (1$$

Since by definition the vertical shear at any transverse section is the sum of the vertical forces to the left of the section, the shear at Station A including point loads is:

$$V(x) = \int_0^x f(\xi)d\xi - \sum_i U_i \, H\,(x - \ell_i) \qquad (2$$

where H(z) is the Heaviside unit function such that

$$H(z) = 1, \quad z > 0$$
$$H(z) = 0, \quad z < 0$$

Similarly the bending moment at Station A is given by:

$$M(x) = \int_0^x (x - \xi)\ f(\xi)d\xi \ - \sum_i \ (x - \ell_i)\ U_i H\ (x - \ell_i) \qquad (3$$

assuming that there are no pure couples present.

The components of the shear force and bending moment are the distributed force, weight and acceleration, and the point loads. These components are shown on Figure 23 and tabulated in Table 8 for Run 262. To determine the shear force and bending moment Equations 2 and 3 were integrated numerically and evaluated for each station as shown in Table 8: the results are shown in columns 7 and 9 of this table. As a result of this first evaluation finite values of shear force and bending moment were obtained at the bow, Station 85.8.

One of the purposes of this analysis was to validate the method used by PMS-304 for determining the hydrodynamic force. In view of the arbitrary nature of this method it seemed natural to ascribe the discrepancy in the shear force and bending moment to the method used to obtain the hydrodynamic force. It was decided to make adjustments to the hydrodynamic force on the bow and stern modules, leaving the mid-body force unchanged, in order to obtain zero shear force and bending moment at the bow. Accordingly the hydrodynamic force on the stern module was increased by .067 lb/in and decreased by .073 lb/in over the bow module, these changes correspond to +11% and -9% respectively of the original bow and stern hydrodynamic forces. The modification is illustrated on Figure 23 and included in the adjusted shear force and bending moments in the last two columns of Table 8. The calculated forces and moments at the fore and aft segmented cuts (Stations 60 and 21) may be found from this table and are compared with the measurements on Page 18. The observed values of shear force and bending moment are plotted on Figure 24.

Discussion of Loads Analysis

The degree of agreement of the calculated shear force and bending moments with the experimental values is quite creditable considering the magnitude of the maximum shear and bending. The calculated bending moments are in the error by 0.8 ft-lb at the forward cut and -1.4 ft-lb at the aft cut; the calculated shear forces are in error by 1.2 lb and -1.9 lb at these two locations.

It is worth noting in Table 8 the large changes brought about in the bending moment by the small change in the water force; this change was necessary in order to close the bending moment diagram. As a consequence the calculated bending moment at the two cuts was reduced by more than 50%. When necessary modest changes to the hydrodynamic force can have such a profound effect on the calculated bending moments it must be concluded on the basis of this experiment that there is no reason to reject the hypothesis that the hydrodynamic force is due, in the main, to the hydrostatic head.

In view of the reasonable agreement between the observed and the calculated instantaneous shear force and bending moment, this analysis could be extended to deal with the instant of peak bending moment. At this instant the assumption about the hydrodynamic force would have to be broadened. This could be done, for example, by assuming the hydrodynamic force to consist of a distributed force analogous to the hydrostatic pressure together with a point load acting on the bow ramp. In order to provide an estimate of the maximum bending moment and its location, it is not essential to consider the fine detail of the loading. For example, the fact that the slamming pressure patch has dimension and is not concentrated in a point is only of importance to the local structure; from the mid-ship location the bending moment due to this patch can indeed be represented by a point load.

The knowledge of the bending moment at one arbitrary location, the weight distribution and the observed acceleration distribution together with the constraints of the problem, supplemented by the assumption that the instantaneous hydrodynamic force consists of a distributed load and a point load, are enough to yield an explicit solution to the problem of calculating the maximum bending moment throughout the slam cycle.

While the proposed analysis is straight forward it is outside the scope of the present study. It should be considered for use in future experimental work because if upon examination it produces useful results, the entire analysis could be integrated with the data reduction process to yield on-line estimates of the magnitude and location of the peak bending moment throughout the slam cycle.

The time history of this maximum bending moment should be recorded and analyzed statistically during rough water operation, in order to achieve the goal of predicting long term bending moment maxima. It should be remarked it is not possible to obtain the equivalent information by combining the separate statistics of, for example, the acceleration and the forward bending moment.

Off-Cushion Response In Large Head Seas (Configuration 2)

The second configuration of the sidewall SES model was tested at low speed in large sea states in order to get some large statistical samples. The test conditions are given in the following table both model scale and full-size assuming a scale ratio of 1/30.

TABLE OF LOW-SPEED HIGH SEA STATE
TEST CONDITIONS

	Model Values	Full Scale (1/30 Scale Ratio)
Load	56.14 lb	700 tons
LCG	47.7 %	47.7%
Run 267		
Significant wave height	6.1 in	15 ft
Speed	2.47 fps	8 knots
Exposure to waves	3.08 min	16.9 min
Run 269		
Significant wave height	7.5 in	19 ft
Speed	1.23 fps	4 knots
Exposure to waves	6.18 min	33.9 min
Load	77.14 lb	955 tons
LCG	47.7%	47.7%
Run 277		
Significant wave height	6.1 in	15 ft
Speed	2.47 fps	8 knots
Exposure to waves	3.08 min	16.8 min
Run 272		
Significant wave height	7.5 in	19 ft
Speed	1.23 fps	4 knots
Exposure to waves	6.00 min	32.9 min

The combination of speeds and significant wave heights (8 knot in 15 ft and 4 knots in 19 ft waves) was selected by PMS-304 as a tentative operating boundary. It may be seen that the exposure to the waves lasted for times corresponding to between 17 to 34 minutes, which are similar to the duration of typical full-scale trials. The results of these tests are given model scale in Table 9 in the form of "peak-trough" statistics, one run to a page. From this table it may be shown that at the low speed there are about 940 structural oscillations and 600 at the higher speed, both corresponding to about 30 cycles per minute full-scale.

The objective in collecting these long samples is to provide data which may be used in the prediction of maximum structural loads over the lifetime of the ship. It is assumed that for any given set of operating conditions (sea, speed, displacement) there exists a population or universe of peak bending loads, for instance, and we are interested in drawing inferences about the universe from the sample.

In order to make predictions about the lifetime maximum bending moment at the forward cut it is necessary (but not sufficient) to know the probability distribution of the underlying parent population. To this end the data at hand is regarded as a random sample drawn from the parent population. The phrase "random sample" implies that each individual from the universe has an equal and independent chance to be included in the sample. From such independent samples we may draw inferences concerning the universe.

The first step, therefore, in processing the samples of the maximum of the bending moment at the forward cut is to check that they are independent samples. This is done by the means of Run Test[2]. The bending moment peaks are arranged in their original observed chronological sequence and tested for independence. If the sample fails the test every second point is selected from the sample and the Run Test repeated, then every third point is selected from the original sample and so on until the test is passed and the points selected form a random sample. This test was run at the 5% level of significance which means that there is a 5% chance of accepting a sample as independent when in fact it is not.

Generally, every fifth peak in the forward bending moment time history was retained corresponding to about 7 samples per minute full-scale. The observed frequency distribution of forward bending moment for the four runs is given in the following table:

Model Peak Bending Moment at Forward Cut, ft-lb Lower Class Bound	Class Mark	Upper Class Bound	RUN 267	269	277	272
			Frequency			
	-7.5		1	0	0	1
	-2.5		3	1	2	2
0	2.5	4.99	54	35	37	33
	7.5		47	65	28	87
	12.5		27	25	12	55
	17.5		16	32	10	25
	22.5		17	9	8	17
	27.5		4	7	5	7
	32.5		2	6	3	3
	37.5		2	3	0	2
	42.5		3	1	2	1
	47.5		4	0	2	3
	52.5		3	1		1
	57.5			0		1
	62.5			0		
	67.5			2		
		N	183	187	109	238
		Mean	12.01	12.71	16.17	12.14
		Standard Deviation	11.73	10.74	10.66	9.38

This same data is shown in the form of histograms on Figure 25 where it may be seen that the peak forward bending moment distributions are broadly similar: 90% of the data lying in the range -10 to 25 ft-lb, and the rest of the data in a long "exponential" tail. It is not possible to guess at the distribution function and indeed there might be two functions governing the data one below 25 ft-lb and perhaps due to a wave mechanism, and another above 25 ft-lb due to a slamming mechanism

The probability distributions are shown on Gumbel[3] extremal paper on Figure 26. Gumbel paper is ruled for the distribution of extremes and is used for convenience, not because there is any reason to assume that the distribution of extremes is the appropriate population from which these samples come. Quite by chance the plot turns out fairly linear and so a line is drawn through the data by inspection. A modest extrapolation of this line suggests that there would be only 1 chance in 1,000 of the peak model bending moment exceeding 80 ft-lb, ±20% to allow for variability in the high tail of these distributions.

For the limited range investigated it appears that the bending moment is independent of model weight. It is worth remarking that for all these test conditions the numerical sum of the full-scale speed in knots and the significant wave height in feet is 23. Also the distance travelled in collecting each of these samples represents 65 ship lengths.

Based on these data a possible statement about the full size ship (assuming a 1/30 scale) might be:

> At weights from 700 to 1,000 tons, there is a probability of 1/1,000 of the peak bending moment 60 ft aft of the bow exceeding 30,000 ft-long tons for every 2 1/4 nautical miles steamed in conditions such that the sum of the speed and signifigant height does not exceed 23.

In these circumstances the L/B=6 SES might be expected to travel 2,250 nautical miles off-cushion before the forward bending moment exceeded 30,000 ft-long tons. Evidentally the relevance of this statistic to the lifetime criterion depends on the total operational scenario contemplated for the L/B=6 buoyant sidewall SES.

The prediction of the long term maximum moment depends at least on a knowledge of the statistical distribution of the bending moment. To guess at the distribution on the basis of the sample characteristics, as has been done by implication on Figure 26, and to use the sample to estimate the population parameters does not seem an objective method of estimating lifetime maxima.

Unfortunately it appears that the distribution of bending moments arising from slamming is unlike that due to wave induced loads and that even at low speeds off-cushion the distribution is not even approximately Rayleigh. Therefore a larger data base is needed to permit the reliable prediction of lifetime criteria relevant to SES operation.

The purpose in estimating the lifetime loading criteria is to permit the development of an efficient structural design which is strong enough for its purpose without being too strong, and consequently unduly heavy, thereby penalizing the payload carrying capability. From this point of view it would seem that the selection of a statistical distribution should take into consideration the structural implications, by means of a sensitivity analysis to show how important the precise distribution is in determining the weight of the structure.

CONCLUDING REMARKS

The results of an experimental investigation of the hydrodynamic characteristics of a L/B=6 buoyant sidewall SES operating off-cushion in calm water have been presented and discussed.

A segmented model was developed for these tests to permit the experimental determination of the shear force and bending moment at two locations (29% and 75% of the length from the bow), and a fundamental bending frequency of 50 Hz was achieved.

Tests of the model in calm water showed a mild drag sensitivity to trim changes and modifications to the shape of the aft sidewall left the drag unaltered at low speeds (speed-length ratios below 1.5).

Fixed trim and heave tests were run at conditions typical of on-cushion attitudes in order to determine the drag contribution of the sidewalls to cushion-borne operation. The form drag of the sidewalls was found to be equal to the skin friction drag, so that the total hydrodynamic drag of the buoyant sidewalls is twice the friction drag at shallow immersion.

An important part of the investigation was the experimental determination of the time history of the shear force and bending moment during off-cushion slamming in regular waves. Detailed time histories of these events were recorded, together with high-speed motion pictures of the bow ramp wetting during the slam and underwater still pictures of the immersed sidewalls. These results are intended to provide the material for subsequent validation of the computer simulation of SES off-cushion slamming.

A secondary objective of the regular wave slam tests was to provide a verification of the assumption that the contribution of the sidewalls to the shear force and bending moment was due to the hydrostatic pressure on the sidewalls arising from their local immersion in the wave. A detailed analysis of one slam event is presented which suggests that there is no reason to reject this assumption.

In order to provide data relevant to the lifetime bending moments to be used in the structural design of the L/B=6 buoyant sidewall SES extended tests were made off-cushion at low speed in irregular waves, corresponding to sea state 6 at a design weight of 700 tons. The statistics of the off-cushion forward bending moment are presented and discussed. It is observed that the complete operational scenario both on and off-cushion would be required to predict lifetime loads. It is concluded that there is insufficient data at this time to identify the off-cushion bending moment probability distribution.

REFERENCES

1. Fridsma, Gerard and Klosinski, Walter E.: Experimental Study of SES Bow Slamming in Regular Waves, Davidson Laboratory Report 2106, October 1980.

2. Bendat, Julius S. and Piersol, Allan G.: Random Data: Analysis and Measurement Procedures, Miley Interscience, Published 1971.

3. Gumbel, E. J.: Statistics of Extremes, Columbia University Press, Published 1958.

TABLE 1

MODEL PARTICULARS

Length Overall, in	85.8
Length Between Perpendiculars, in	84.8
Width Overall, in	20.0
Bow Ramp Dimensions:	
Length, in	8.25
Width, in	12.17
Angle, deg	15.0
Knuckle forward of transom, in	77.2
Pivot Point:	
Forward of transom, in	42.18
Height above keel, in	8.30
Split Locations Forward of Transom:	
Forward split, in	60.24
Aft split, in	21.06
Accelerometer Locations Forward of Transom:	
Bow #1, in	76.6
Bow #2, in	61.9
CG #1, in	57.1
CG #2, in	24.4
Sidewall Dimensions:	
Length, in	84.8
Height to wet deck, in	6.17
Width, in:	
Maximum at wet deck	9.08
Maximum at 3.2 in. waterline	5.60
Deadrise, outboard and aft of bow, deg	40.75

TABLE 2

MASS DISTRIBUTION CHARACTERISTICS

The buoyant sidewall SES model was divided into 28 three-inch-long segments plus the stem segment of 1.8 inches. The table below presents the properties of each segment as to its weight, center-of-gravity, and inertia relative to the transom. The overall weight characteristics are also summarized. This particular table applies for the wave tests where the weight less unloading accounts for a load on water of 56.13 lbs and center of buoyancy of 40.47 inches.

The values presented were obtained from careful weighings of each structural component as they were constructed and installed on the model including plywood, foam, aluminum supports, balances, etc.

Segment			Concentrated Loads		Total Moment About Transom	Total Inertia About Transom
Extent in	LCS* in	Weight lb	Position in	Weight lb	in-lb	slug-ft^2
0-3	1.5	2.204			3.306	0.00
3-6	4.5	1.695			7.628	0.01
6-9	7.5	1.931			14.483	0.02
9-12	10.5	2.161			22.691	0.05
12-15	13.5	2.505			33.818	0.10
15-18	16.5	2.546			42.009	0.15
18-21	19.5	2.606			50.817	0.21
21-24	22.5	3.662	22.63	9.40	295.117	1.44
24-27	25.5	2.270			57.885	0.32
27-30	28.5	2.007			57.199	0.35
30-33	31.5	2.190			68.985	0.47
33-36	34.5	2.117			73.037	0.54
36-39	37.5	3.206			120.225	0.97
39-42	40.5	2.997			121.378	1.06
42-45	43.5	2.263	42.18	16.13	778.804	7.12
45-48	46.5	2.727			126.806	1.27
48-51	49.5	2.047			101.327	1.08
51-54	52.5	2.210			116.025	1.31
54-57	55.5	2.027			112.499	1.35
57-60	58.5	3.675	58.67	3.40	414.466	5.25
60-63	61.5	3.418			210.207	2.79
63-66	64.5	2.638			170.151	2.37
66-69	67.5	3.703			249.952	3.64
69-72	70.5	2.494			175.827	2.67
72-75	73.5	2.954			217.119	3.44
75-78	76.5	2.412			184.518	3.04
78-81	79.5	1.336			106.212	1.82
81-84	82.5	1.261			104.033	1.85
84-85.8	84.9	0.536			45.506	0.83
		69.798		28.93	4082.03	45.52

* Longitudinal distance from transom to center of segment

Summary: Total weight = 98.73 lb

LCG = 4082.0/98.73 = 41.35 in (3.45 ft)

Inertia about LCG = 9.11 slug ft , gyradius = 1.72 ft (24% LOA)

TABLE 3
CALM WATER DATA
Configuration 1

RUN	LOAD LB	LCG IN	SPEED FPS	TRIM DEG	DRAFT IN	DRAG LB
82	56.14	32.78	0.00	0.77	3.16	0.00
83	56.14	32.78	2.46	0.85	3.17	0.54
84	56.14	32.78	3.70	0.91	3.19	1.28
76	56.14	32.78	4.62	1.12		2.35
85	56.14	32.78	4.93	1.15	3.23	3.09
47	56.14	35.17	0.00	0.21	3.26	0.00
50	56.14	35.17	1.23	0.18	3.12	0.06
51	56.14	35.17	2.46		3.12	0.44
52	56.14	35.17	3.70	0.18	3.14	1.18
57	56.14	35.17	4.31	0.27	3.17	1.77
53	56.14	35.17	4.93	0.13	3.23	2.87
58	56.14	35.17	4.93	0.44	3.24	2.85
54	56.14	35.17	6.16	0.34	3.30	3.68
55	56.14	35.17	7.39	1.15	3.31	4.65
56	56.14	35.17	8.62	1.38	3.20	5.53
86	56.14	37.51	0.00	-0.35	3.26	0.00
87	56.14	37.51	2.46	-0.38	3.26	0.45
88	56.14	37.51	3.70	-0.29	3.01	1.19
77	56.14	37.51	4.62	-0.24	2.93	2.17
89	56.14	37.51	4.93	-0.13	3.04	2.70
78	56.14	40.72	0.00	-1.07	3.31	0.00
79	56.14	40.72	4.62	-1.06	3.46	2.11
80	56.14	42.64	0.00	-1.48	3.36	0.00
81	56.14	42.64	4.62	-1.53	3.50	2.05

TABLE 3
(Continued)

RUN	LOAD LB	LCG IN	SPEED FPS	TRIM DEG	DRAFT IN	DRAG LB
96	77.14	38.33	0.00	-0.52	3.99	0.00
108	77.14	38.33	3.70	-0.54	4.03	1.48
109	77.14	38.33	4.31	-0.52	4.08	2.34
97	77.14	38.33	4.62	-0.37	4.15	2.69
110	77.14	38.33	4.93	-0.20	4.13	2.54
94	77.14	40.35	0.00	-1.04	4.02	0.00
101	77.14	40.35	1.23	-0.96	3.94	0.08
102	77.14	40.35	2.46	-1.00	3.93	0.46
103	77.14	40.35	3.70	-1.03	4.03	1.44
104	77.14	40.35	4.31	-1.05	4.02	2.28
95	77.14	40.35	4.62	-1.11	4.20	2.65
105	77.14	40.35	4.93	-0.95	4.04	3.50
106	77.14	40.35	6.16	-1.25	4.15	5.05
107	77.14	40.35	7.39	0.13	4.38	7.16
91	77.14	42.12	0.00	-1.51	4.07	0.00
111	77.14	42.12	3.70	-1.63	4.13	1.38
112	77.14	42.12	4.31	-1.73	4.17	2.24
92	77.14	42.12	4.62	-1.60	4.31	2.70
93	77.14	42.12	4.62	-1.61	4.26	2.68
113	77.14	42.12	4.93	-1.67	4.26	3.25
114	77.14	42.12	6.16	-1.93	4.41	5.33

TABLE 4

CALM WATER DATA

Configuration 2

RUN	LOAD LB	LCG IN	SPEED FPS	TRIM DEG	DRAFT IN	DRAG LB
186	36.35	37.08	0.00	0.42	2.70	0.00
187	36.35	37.08	4.30	0.46	2.80	1.31
184	36.35	38.76	0.00	0.13	2.71	0.00
185	36.35	38.76	4.31	0.13	2.83	1.29
194	36.35	40.44	0.00	-0.21	2.73	0.00
191	36.35	40.44	1.23	-0.21	2.73	0.10
192	36.35	40.44	2.47	-0.23	2.80	0.42
193	36.35	40.44	3.70	-0.24	2.83	1.01
183	36.35	40.44	4.31	-0.20	2.88	1.24
195	36.35	40.44	4.93	-0.15	2.90	1.91
199	36.35	40.44	5.49	-0.33	2.88	2.19
196	36.35	40.44	6.12	-0.23	2.93	2.44
197	36.35	40.44	7.27	0.17	2.98	3.21
198	36.35	40.44	8.50	0.57	2.96	4.09
180	36.35	42.12	0.00	-0.52	2.77	0.00
181	36.35	42.12	4.31	-0.58	2.87	1.27
188	36.35	43.80	0.00	-0.83	2.76	0.00
189	36.35	43.80	4.30	-0.93	2.89	1.28
200	56.14	40.44	0.00	-0.24	3.46	0.00
201	56.14	40.44	2.47	-0.27	3.51	0.49
202	56.14	40.44	3.70	-0.32	3.58	1.25
203	56.14	40.44	4.30	-0.39	3.58	1.69
204	56.14	40.44	4.89	-0.29	3.65	2.61
205	56.14	40.44	6.15	-0.37	3.70	3.56
206	56.14	40.44	7.39	0.39	3.77	5.11
207	56.14	40.44	8.65	0.80	3.70	6.23

TABLE 4
(Continued)

RUN	LOAD LB	LCG IN	SPEED FPS	TRIM DEG	DRAFT IN	DRAG LB
169	77.14	36.80	0.00	0.62	4.01	0.00
170	77.14	36.80	4.30	0.63	4.17	2.24
159	77.14	38.57	0.00	0.12	4.11	0.00
160	77.14	38.57	4.26	0.04	4.31	2.12
162	77.14	38.57	4.34	0.07	4.26	2.21
163	77.14	40.44	0.00	-0.39	4.10	0.00
172	77.14	40.44	1.23	-0.39	4.10	0.12
173	77.14	40.44	2.47	-0.42	4.15	0.58
174	77.14	40.44	3.70	-0.47	4.24	1.64
157	77.14	40.44	4.26	-0.53	4.35	2.05
164	77.14	40.44	4.31	-0.54	4.28	2.15
175	77.14	40.44	4.86	-0.48	4.31	3.40
176	77.14	40.44	6.02	-0.53	4.40	4.63
177	77.14	40.44	6.12	-0.61	4.41	4.75
178	77.14	40.44	7.21	0.47	4.47	6.92
179	77.14	40.44	8.62	1.38	4.38	9.52
165	77.14	42.12	0.00	-0.86	4.10	0.00
166	77.14	42.12	4.31	-1.37	4.29	2.19
155	77.14	42.12	4.32	-1.36	4.42	2.18
167	77.14	43.80	0.00	-1.29	4.17	0.00
168	77.14	43.80	4.30	-1.60	4.40	2.25

TABL 5

CALM WATER DATA-FIXED TRIM AND HEAVE

Configuration 2

RUN	DRAFT IN	TRIM DEG	SPEED FPS	DRAG* LB
217	0.80	-0.43	6.13	0.75
221	0.80	-0.46	9.20	1.48
222	0.80	-0.49	12.24	2.45
223	0.80	-0.54	15.39	4.11
224	0.80	-0.62	18.48	5.82
210	0.80	-0.03	6.23	0.66
212	0.80	0.01	9.09	1.34
211	0.80	0.03	9.10	1.39
225	0.80	-0.02	12.30	2.31
215	0.80	-0.03	15.38	3.88
226	0.80	-0.06	15.43	3.65
216	0.80	-0.09	18.48	5.62
234	0.80	0.55	6.16	0.62
235	0.80	0.56	9.24	1.34
236	0.80	0.51	12.25	2.23
237	0.80	0.48	15.41	3.43
238	0.80	0.54	18.51	5.11
245	1.63	-0.59	6.18	1.21
246	1.63	-0.48	9.26	2.51
247	1.63	-0.54	12.31	4.29
248	1.63	-0.61	15.39	6.77
249	1.63	-0.70	18.46	10.17
240	1.63	-0.05	6.15	1.24
256	1.63	0.01	9.23	2.53
257	1.63	-0.08	10.80	3.27
242	1.63	-0.08	12.31	4.12
243	1.63	-0.06	15.39	6.39
244	1.63	-0.08	18.44	9.68
250	1.63	0.51	6.17	1.29
251	1.63	0.54	9.25	2.88
252	1.63	0.48	12.30	4.31
253	1.63	0.43	15.39	6.42
254	1.63	0.42	18.46	9.67

*Includes Air Tare: $D_{air} = .00063V^2$

TABLE 6

REGULAR WAVE RESULTS

Configuration 2

Load 56.14 lb   LCG 40.44

RUN NO.		260	261	262	263	264
Speed,	fps	1.14	2.56	1.23	2.45	2.43
Wave Period,	sec	1.20	1.19	1.35	1.35	1.50
Wave Length,	ft	7.4	7.3	9.3	9.3	11.4
Wave Height,	in	5.9	4.0	6.1	4.0	6.0
Encounter Period,	sec	1.00	0.85	1.15	1.00	1.14
Pitch	deg					
Mean		0.10	-0.44	-0.30	-0.45	-0.06
RMS		3.35	2.31	3.55	3.07	4.21
Avg. Crest		4.44	2.66	4.75	3.57	5.18
Avg. Trough		-5.19	-3.99	-5.25	-5.27	-6.93
Height of Tow Point,	in					
Mean		4.88	4.85	4.93	4.93	4.93
RMS		0.54	0.49	1.09	0.82	1.58
Avg. Crest		5.77	5.59	6.50	6.13	7.27
Avg. Trough		4.22	4.21	3.45	3.84	2.75
Shear Forward,	lb					
Mean		-0.74	-0.13	-0.77	-0.57	-0.83
RMS		4.87	4.17	3.08	3.61	4.30
Avg. Maximum		-10.00	-13.00	-7.00	-11.00	-14.00
Bending Moment Forward,	ft-lb					
Mean		0.42	-0.08	0.59	0.19	0.67
RMS		5.02	7.83	3.79	3.09	4.39
Avg. Maximum		18.00	32.00	11.00	12.00	18.00
Shear Aft,	lb					
Mean		0.47	-0.02	0.66	0.24	0.83
RMS		4.82	3.88	2.41	3.46	4.30
Avg. Maximum		8.00	12.00	5.00	6.00	8.00
Bending Moment Aft,	ft-lb					
Mean		0.87	0.58	0.95	0.85	1.43
RMS		5.36	4.56	2.60	3.91	4.74
Avg. Maximum		7.00	11.00	3.00	5.00	8.00
Bow Acceleration, #1	g					
RMS		0.32	0.32	0.28	0.28	0.34
Avg. Maximum		1.05	1.20	0.69	0.90	1.51
Bow Acceleration, #2	g					
RMS		0.24	0.30	0.21	0.19	0.26
Avg. Maximum		1.02	1.40	0.62	0.67	1.46
CG Acceleration, #1	g					
RMS		0.17	0.19	0.17	0.16	0.21
Avg. Maximum		0.57	0.75	0.37	0.55	0.79
CG Acceleration, #2	g					
RMS		0.13	0.12	0.05	0.11	0.15
Avg. Minimum		-0.40	-0.39	-0.17	-0.23	-0.35
Height of Knuckle,	in					
Mean		2.66	2.46	2.80	2.58	2.62
RMS		2.63	1.77	3.33	2.43	3.55
Avg. Crest		6.05	4.93	7.54	5.84	7.42
Avg. Trough		-1.39	-0.12	-1.69	-1.07	-2.62
Wave Elevation,	in					
Mean		0.07	0.41	0.15	0.41	0.37
RMS		1.81	1.31	2.18	1.43	2.11
Avg. Crest		2.84	2.32	3.27	2.52	3.51
Avg. Trough		-2.37	-1.38	-2.96	-1.52	-2.53

TABLE 7

BUOYANCY RESULTS FROM UNDERWATER PICTURE FOR RUN 262

Station	Wetted Water Line	Submerged Area	Segment		
				Buoyancy	
			LCS*	Force	Moment
in.	in.	in^2		lb.	ft-lb
0	3.2	13.17	1.5	1.43	0.18
3	3.2	13.17	4.5	1.43	0.54
6	3.2	13.17	7.5	1.43	0.89
9	3.2	13.17	10.5	1.43	1.25
12	3.2	13.17	13.5	1.99	2.24
15	3.2	23.50	16.5	2.47	3.40
18	3.2	22.15	19.5	2.33	3.79
21	3.2	20.80	22.5	2.09	3.92
24	3.2	19.46	25.5	2.06	4.38
27	3.2	18.56	28.5	2.26	5.37
30	3.6	23.23	31.5	2.26	5.93
33	3.2	18.56	34.5	2.01	5.78
36	3.2	18.56	37.5	2.07	6.47
39	3.3	19.69	40.5	1.90	6.41
42	2.9	15.35	43.5	1.84	6.67
45	3.2	18.56	46.5	2.40	9.30
48	3.8	25.70	49.5	2.58	10.64
51	3.5	22.02	52.5	2.20	9.63
54	3.2	18.56	55.5	2.01	9.30
57	3.2	18.56	58.5	2.41	11.75
60	3.6	23.23	61.5	2.70	13.84
63	4.0	26.64	64.5	3.26	17.52
66	4.8	33.50	67.5	3.78	21.26
69	5.4	36.20	70.5	3.70	21.74
72	5.6	32.06	73.5	3.20	19.60
75	5.6	26.96	76.5	2.59	16.51
78	5.8	20.95	79.5	1.76	11.66
81	6.0	11.56	82.5	0.66	4.54
84	6.17	0.61			
			Totals	62.25	234.51

* Longitudinal Centroid of Segment (relative to transom)

Instantaneous Moment Center = 234.51/62.25 = 3.77 ft (45.21 in)

TABLE 8

CALCULATED INSTANTANEOUS SHEAR FORCE AND BENDING MOMENT ANALYSIS AT 0.41 SECONDS FOR RUN 262

SEGMENT COMPONENTS									ADJUSTED	
STATION in.	LCS in.	BUOYANT FORCE lb.	WEIGHT lb.	ACCELERATION g's	NET FORCE f lb.	SHEAR FORCE V(x) lb.	V(x)Δx ft-lb	BENDING MOMENT M(x) ft-lb	SHEAR FORCE V(x) lb.	BENDING MOMENT M(x) ft-lb
0						0		0	0	0
	1.5	1.43	2.20	-0.123	- 0.50		-0.06			
3						- 0.50		- 0.06	- 0.30	- 0.04
	4.5	1.43	1.70	-0.110	- 0.08		-0.14			
6						- 0.58		- 0.20	- 0.18	- 0.10
	7.5	1.43	1.93	-0.096	- 0.32		-0.19			
9						- 0.90		- 0.39	- 0.30	- 0.16
	10.5	1.43	2.16	-0.082	- 0.55		-0.29			
12						- 1.45		- 0.68	- 0.65	- 0.28
	13.5	1.99	2.51	-0.069	- 0.34		-0.41			
15						- 1.79		- 1.09	- 0.79	- 0.46
	16.5	2.47	2.55	-0.055	0.06		-0.44			
18						- 1.73		- 1.53	- 0.53	- 0.62
	19.5	2.33	2.61	-0.041	- 0.17		-0.45			
21						- 1.90		- 1.98	- 0.50	- 0.75
	21.8	1.14	1.99	-0.031	- 0.79		-0.31			
22.63						- 2.69			- 1.29	
22.63	concentrated load		9.40	-0.027	- 9.15	-11.84		- 2.29	-10.44	- 0.87
	23.3	0.95	1.67	-0.024	- 0.68		-1.39			
24						-12.52		- 3.68	-11.12	- 2.10
	25.5	2.06	2.27	-0.014	- 0.18		-3.15			
27						-12.70		- 6.83	-11.30	- 4.91
	28.5	2.26	2.01	0.0	0.25		-3.14			
30						-12.45		- 9.97	-11.05	- 7.70
	31.5	2.26	2.19	0.013	0.04		-3.11			
33						-12.41		-13.08	-11.01	-10.46
	34.5	2.01	2.12	0.027	- 0.17		-3.12			
36						-12.58		-16.20	-11.18	-13.23
	37.5	2.07	3.21	0.041	- 1.27		-3.30			
39						-13.85		-19.50	-12.45	-16.19
	40.5	1.90	3.00	0.054	- 1.26		-3.62			
42						-15.11		-23.12	-13.71	-19.46
	42.09	0.11	0.13	0.062	- 0.03		-0.23			
42.18	unloading force		42.2			-15.14			-13.74	
42.18	concentrated load		16.13	0.062	25.07	9.93		-23.35	11.33	-19.66
	43.6	1.73	2.13	0.068	- 0.54		2.27			
45						9.39		-21.08	10.79	-17.06
	46.5	2.40	2.73	0.082	- 0.55		2.28			
48						8.84		-18.80	10.24	-14.43
	49.5	2.58	2.05	0.095	0.34		2.25			
51						9.18		-16.55	10.58	-11.83
	52.5	2.20	2.21	0.109	- 0.25		2.26			
54						8.93		-14.29	10.33	- 9.22
	55.5	2.01	2.03	0.123	- 0.27		2.20			
57						8.66		-12.09	10.06	- 6.67
	57.8	1.31	2.00	0.133	- 0.96		1.14			
58.67						7.70			9.10	
58.67	concentrated load		3.40	0.137	- 3.87	3.83		-10.95	5.23	- 5.34
	59.3	1.10	1.68	0.140	- 0.82		0.38			
60						3.01		-10.57	4.41	- 4.80
	61.5	2.70	3.42	0.150	- 1.23		0.60			
63						1.78		- 9.97	2.96	- 3.88
	64.5	3.26	2.64	0.163	0.19		0.47			
66						1.97		- 9.50	2.93	- 3.14
	67.5	3.78	3.70	0.177	- 0.57		0.42			
69						1.40		- 9.08	2.14	- 2.51
	70.5	3.70	2.49	0.191	0.73		0.44			
72						2.13		- 8.64	2.65	- 1.91
	73.5	3.20	2.95	0.204	- 0.35		0.49			
75						1.78		- 8.15	2.08	- 1.32
	75.9	1.47	1.37	0.215	- 0.19		0.24			
76.7						1.59			1.77	
76.7	unloading force		0.40		0.40	1.99		- 7.91	2.17	- 1.05
	77.4	1.12	1.04	0.222	- 0.15		0.21			
78						1.84		- 7.70	1.92	- 0.83
	79.5	1.76	1.34	0.232	0.11		0.47			
81						1.95		- 7.23	1.81	- 0.36
	82.5	0.66	1.26	0.245	- 0.91		0.37			
84						1.04		- 6.86	0.68	- 0.05
	84.9	0	0.54	0.256	- 0.68		0.11			
85.8						0.36		- 6.75	0	0.04

TABLE 9

RUN DIRECTORY

Configuration 1 in Irregular Waves

Load 56.14 lb. LCG 35.17 inches

Significant Wave Height, Inches	0.98	1.82	2.75
Speed, fps			
1.23	59	67	-
2.47	60	68	73
3.70	61	69	74
4.94	62	70	75
6.17	63	71	-
7.40	65	72	-
8.64	66	-	-

Load 77.14 lb. LCG 40.35 inches

Significant Wave Height, Inches	0.98	1.82	2.75
Speed, fps			
1.23	115	121	-
2.47	116	122	127
3.70	117	124	128
4.94	118	125	129
6.17	119	126	-
7.40	120	-	-

DAVIDSON LABORATORY 30-JUL-80

SES BUOYANT SIDEWALL, LOAD TEST MODEL

RUN 59 SPEED = 1.23 FPS

SPEED 1.23 FPS WAVE ENCOUNTERS 266
DRAG 0.11 LB SIGNIFICANT WAVE HEIGHT 0.98 IN
LOAD 56.14 LB LCG 35.17 IN

	MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH DEG.	-0.006	133	0.27	0.43	0.73	1.99
	0.135		-0.26	-0.40	-0.60	-1.91
HEAVE IN.	4.876	6	4.42			5.65
	0.022		4.57			4.06
SHEAR FWD LB						
BM FWD LB-FT	-2.557	177	-1.55	-0.69	1.32	25.35
	0.570		-3.39	-3.89	-4.55	-9.32
SHEAR AFT LB	-0.371	194	0.52	0.98	1.65	5.20
	0.465		-1.21	-1.60	-2.03	-5.44
BM AFT LB-FT	-0.507	153	0.44	1.02	2.16	8.40
	0.433		-1.42	-1.87	-2.65	-9.12
BOW ACC #1G	-0.013	2	0.05			0.10
	0.016		-0.20			-0.23
BOW ACC #2G	-0.014	2	0.07			0.14
	0.011		-0.22			-0.25
CG ACC #1 G	-0.004	2	0.07			0.15
	0.010		-0.21			-0.24
CG ACC #2 G	-0.009	3	0.11			0.20
	0.011		-0.16			-0.22
WAVE , IN.	-0.383	265	0.08	0.39	0.61	1.17
	0.331		-0.79	-1.02	-1.19	-1.79

DAVIDSON LABORATORY 30-JUL-80

SES BUOYANT SIDEWALL, LOAD TEST MODEL

RUN 60

SPEED 2.47 FPS
DRAG 0.52 LB
LOAD 56.14 LB

WAVE ENCOUNTERS 166
SIGNIFICANT WAVE HEIGHT 0.98 IN
LCG 35.17 IN

	MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH DEG.	0.221	74	0.47	0.57	0.62	0.69
	0.140		-0.03	-0.12	-0.16	-0.22
HEAVE IN.	4.897	0	0.00	0.00	0.00	0.00
	0.014		0.00	0.00	0.00	0.00
SHEAR FWD LB	+2.217	57	+0.96	+0.61	+0.39	- 0.06
	0.570		+3.64	+4.26	+5.45	+10.58
BM FWD LB-FT	-2.055	170	-1.25	-0.92	-0.67	0.68
	0.487		-2.89	-3.36	-3.99	-12.84
SHEAR AFT LB	-0.693	190	0.20	0.65	1.23	
	0.546		-1.60	-2.13	-2.90	
BM AFT LB-FT	-0.615	115	0.17	0.43	0.63	0.91
	0.414		-1.42	-1.71	-1.97	-2.94
BOW ACC #1G	-0.012	0	0.00	0.00	0.00	0.00
	0.021		0.00	0.00	0.00	0.00
BOW ACC #2G	-0.011	0	0.00	0.00	0.00	0.00
	0.016		0.00	0.00	0.00	0.00
CG ACC #1 G	-0.005	0	0.00	0.00	0.00	0.00
	0.015		0.00	0.00	0.00	0.00
CG ACC #2 G	-0.010	0	0.00	0.00	0.00	0.00
	0.015		0.00	0.00	0.00	0.00
WAVE , IN.	-0.021	167	0.35	0.56	0.76	1.10
	0.278		-0.37	-0.60	-0.78	-0.96

DAVIDSON LABORATORY 30-JUL-80

SES BUOYANT SIDEWALL, LOAD TEST MODEL

RUN 61

SPEED 3.70 FPS WAVE ENCOUNTERS 132
DRAG 1.36 LB SIGNIFICANT WAVE HEIGHT 0.98 IN
LOAD 56.14 LB LCG 35.17 IN

	MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH DEG.	0.229	50	0.48	0.58	0.65	0.71
	0.149		-0.03	-0.14	-0.22	-0.25
HEAVE IN.	4.883	2	2.46			4.93
	0.019		4.82			4.82
SHEAR FWD LB						
PM FWD LB-FT	-2.542	73	-1.81	-1.56	-1.39	-1.27
	0.359		-3.26	-3.50	-3.61	-3.72
SHEAR AFT LB	-1.003	84	-0.10	0.27	0.56	0.85
	0.517		-1.98	-2.58	-3.52	-9.00
PM AFT LB-FT	-1.054	75	-0.24	0.02	0.23	0.41
	0.432		-1.85	-2.15	-2.44	-2.74
BOW ACC #1G	-0.009	0	0.00	0.00	0.00	0.00
	0.024		0.00	0.00	0.00	0.00
BOW ACC #2G	-0.013	0	0.00	0.00	0.00	0.00
	0.015		0.00	0.00	0.00	0.00
CG ACC #1 G	-0.008	0	0.00	0.00	0.00	0.00
	0.014		0.00	0.00	0.00	0.00
CG ACC #2 G	-0.014	1	0.00			
	0.014		-0.06			
WAVE , IN.	0.129	132	0.47	0.72	0.96	1.53
	0.262		-0.20	-0.42	-0.61	-0.94

DAVIDSON LABORATORY 30-JUL-80

SES BUOYANT SIDEWALL, LOAD TEST MODEL

RUN 62

SPEED 4.94 FPS WAVE ENCOUNTERS 114
DRAG 2.94 LB SIGNIFICANT WAVE HEIGHT 0.78 IN
LOAD 56.14 LB LCG 35.17 IN

	MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH DEG.	0.395	50	0.61	0.68	0.73	0.79
	0.126		0.16	0.08	0.02	-0.02
HEAVE IN.	4.314	1	4.88			
	0.019		4.75			
SHEAR FWD LB						
BM FWD LB-FT						
SHEAR AFT LB	-1.845	184	-0.91	-0.44	-0.08	1.08
	0.684		-2.79	-3.28	-3.62	-4.25
BM AFT LB-FT	-2.035	110	-1.19	-0.85	-0.54	0.10
	0.508		-2.88	-3.19	-3.46	-4.23
BOW ACC #1G	-0.010	0	0.00	0.00	0.00	0.00
	0.033		0.00	0.00	0.00	0.00
BOW ACC #2G	-0.012	0	0.00	0.00	0.00	0.00
	0.027		0.00	0.00	0.00	0.00
CG ACC #1 G	-0.007	0	0.00	0.00	0.00	0.00
	0.025		0.00	0.00	0.00	0.00
CG ACC #2 G	-0.013	0	0.00	0.00	0.00	0.00
	0.024		0.00	0.00	0.00	0.00
WAVE , IN.	0.161	114	0.51	0.72	0.87	1.09
	0.252		-0.14	-0.35	-0.53	-0.74

DAVIDSON LABORATORY 30-JUL-80

SES BUOYANT SIDEWALL, LOAD TEST MODEL

RUN 63

SPEED 6.17 FPS WAVE ENCOUNTERS 101
DRAG 3.71 LB SIGNIFICANT WAVE HEIGHT 0.98 IN
LOAD 56.14 LB LCG 35.17 IN

	MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH DEG.	0.311	32	0.49	0.54		0.59
	0.086		0.14	0.08		0.02
HEAVE IN.	4.789	0	0.00	0.00	0.00	0.00
	0.019		0.00	0.00	0.00	0.00
SHEAR FWD LB						
BM FWD LB-FT						
SHEAR AFT LB	0.359	102	1.16	1.49	1.64	2.15
	0.489		-0.46	-0.76	-1.02	-1.25
BM AFT LB-FT	0.126	61	0.88	1.10	1.32	1.71
	0.357		-0.58	-0.83	-1.01	-1.21
BOW ACC #1G	-0.005	0	0.00	0.00	0.00	0.00
	0.022		0.00	0.00	0.00	0.00
BOW ACC #2G	-0.012	0	0.00	0.00	0.00	0.00
	0.017		0.00	0.00	0.00	0.00
CG ACC #1 G	-0.010	0	0.00	0.00	0.00	0.00
	0.016		0.00	0.00	0.00	0.00
CG ACC #2 G	-0.012	1	0.00			
	0.015		-0.06			
WAVE , IN.	0.198	101	0.55	0.77	0.96	1.67
	0.253		-0.13	-0.32	-0.44	-0.48

DAVIDSON LABORATORY 31-JUL-80

SES BUOYANT SIDEWALL, LOAD TEST MODEL

RUN 65

SPEED 7.40 FPS WAVE ENCOUNTERS 94
DRAG 4.79 LB SIGNIFICANT WAVE HEIGHT 0.98 IN
LOAD 56.14 LB LCG 35.17 IN

	MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH DEG.	1.148	25	1.33	1.38		1.47
	0.084		0.99	0.93		0.88
HEAVE IN.	4.852	0	0.00	0.00	0.00	0.00
	0.022		0.00	0.00	0.00	0.00
SHEAR FWD LB	+0.388	84	-1.04	-1.53	-1.97	
	0.752		+1.95	+2.66	+3.81	
BM FWD LB-FT	-1.829	143	-0.95	-0.57	-0.34	0.00
	0.557		-2.71	-3.12	-3.40	-3.68
SHEAR AFT LB	-0.618	183	0.34	0.88	1.20	1.53
	0.698		-1.71	-2.28	-2.67	-3.43
BM AFT LB-FT	-0.436	120	0.38	0.72	0.91	1.14
	0.488		-1.32	-1.67	-1.97	-2.38
BOW ACC #1G	-0.004	2	0.05			0.10
	0.032		-0.10			-0.11
BOW ACC #2G	-0.012	0	0.00	0.00	0.00	0.00
	0.025		0.00	0.00	0.00	0.00
CG ACC #1 G	-0.007	0	0.00	0.00	0.00	0.00
	0.024		0.00	0.00	0.00	0.00
CG ACC #2 G	-0.012	0	0.00	0.00	0.00	0.00
	0.022		0.00	0.00	0.00	0.00
WAVE , IN.	0.177	95	0.52	0.74	0.87	1.11
	0.247		-0.14	-0.29	-0.39	-0.63

DAVIDSON LABORATORY 31-JUL-80

SES BUOYANT SIDEWALL, LOAD TEST MODEL

RUN 66

SPEED 8.64 FPS WAVE ENCOUNTERS 94
DRAG 5.74 LB SIGNIFICANT WAVE HEIGHT 0.98 IN
LOAD 56.14 LB LCG 35.17 IN

	MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH DEG.	1.349	25	1.52	1.56		1.65
	0.079		1.20	1.14		1.11
HEAVE IN.	4.911	1	0.00			
	0.023		4.86			
SHEAR FWD LB	+1.695	41	+0.34	-0.06		-0.84
	0.639		+3.05	+3.41		+3.82
BM FWD LB-FT	-2.500	93	-1.67	-1.35	-1.14	-0.75
	0.503		-3.35	-3.74	-3.97	-4.26
SHEAR AFT LB	-1.377	131	-0.47	-0.09	0.22	1.43
	0.533		-2.11	-2.51	-2.77	-2.98
BM AFT LB-FT	-1.164	57	-0.42	-0.17	0.02	0.20
	0.380		-1.88	-2.12	-2.27	-2.52
BOW ACC #1G	-0.010	0	0.00	0.00	0.00	0.00
	0.027		0.00	0.00	0.00	0.00
BOW ACC #2G	-0.012	0	0.00	0.00	0.00	0.00
	0.019		0.00	0.00	0.00	0.00
CG ACC #1 G	-0.007	0	0.00	0.00	0.00	0.00
	0.018		0.00	0.00	0.00	0.00
CG ACC #2 G	-0.011	1	0.00			
	0.017		-0.07			
WAVE , IN.	0.187	94	0.55	0.80	1.01	1.89
	0.264		-0.13	-0.35	-0.48	-0.69

DAVIDSON LABORATORY 31-JUL-80

SES BUOYANT SIDEWALL, LOAD TEST MODEL

RUN 67

SPEED	1.23 FPS	WAVE ENCOUNTERS	204
DRAG	0.07 LB	SIGNIFICANT WAVE HEIGHT	1.82 IN
LOAD	56.14 LB	LCG	35.17 IN

	MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH DEG.	0.098	126	0.77	1.18	1.52	1.97
	0.509		-0.58	-1.01	-1.36	-1.67
HEAVE IN.	5.319	79	5.44	5.51	5.57	5.63
	0.075		5.19	5.12	5.08	5.01
SHEAR FWD LB	+1.677	141	-0.20	-1.11	-1.93	
	1.096		+3.64	+4.73	+5.96	
BM FWD LB-FT	-1.022	166	0.23	0.91	1.44	2.17
	0.833		-2.29	-2.93	-3.37	-4.00
SHEAR AFT LB	-0.094	204	1.40	2.53	3.57	
	1.149		-1.73	-3.03	-4.54	
BM AFT LB-FT	-0.227	149	1.31	2.07	2.72	3.20
	1.056		-1.79	-2.59	-3.21	-3.70
BOW ACC #1G	-0.013	21	0.12	0.15		0.16
	0.045		-0.14	-0.17		-0.18
BOW ACC #2G	-0.018	4	0.07			0.10
	0.029		-0.12			-0.14
CG ACC #1 G	-0.006	1	0.00			
	0.025		-0.10			
CG ACC #2 G	-0.010	0	0.00	0.00	0.00	0.00
	0.020		0.00	0.00	0.00	0.00
WAVE , IN.	-0.310	204	0.38	0.87	1.30	2.10
	0.524		-0.89	-1.24	-1.44	-1.79

DAVIDSON LABORATORY 31-JUL-80

SES BUOYANT SIDEWALL, LOAD TEST MODEL

RUN 68

SPEED 2.47 FPS
DRAG 0.49 LB
LOAD 56.14 LB

WAVE ENCOUNTERS 135
SIGNIFICANT WAVE HEIGHT 1.82 IN
LCG 35.17 IN

	MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH DEG.	0.055	76	0.89	1.41	1.85	2.40
	0.640		-0.79	-1.25	-1.58	-2.01
HEAVE IN.	5.269	52	5.40	5.47	5.53	5.63
	0.081		5.14	5.08	5.06	5.04
SHEAR FWD LB	+2.611	80	+0.78	-0.03	-0.81	
	1.046		+4.59	+5.55	+6.95	
BM FWD LB-FT	-1.683	113	-0.58	-0.00	0.35	0.77
	0.733		-2.82	-3.30	-3.67	-4.38
SHEAR AFT LB	-0.499	117	1.01	1.91	2.75	
	1.077		-1.90	-2.98	-3.79	
BM AFT LB-FT	-0.455	87	1.08	1.86	2.38	2.79
	1.029		-2.00	-2.80	-3.31	-4.04
BOW ACC #1G	-0.010	35	0.14	0.18		0.23
	0.072		-0.16	-0.21		-0.29
BOW ACC #2G	-0.014	11	0.11			0.14
	0.045		-0.14			-0.20
CG ACC #1 G	-0.009	9	0.11			0.13
	0.039		-0.13			-0.17
CG ACC #2 G	-0.013	1	0.00			
	0.029		-0.11			
WAVE , IN.	-0.002	135	0.56	0.99	1.28	1.76
	0.496		-0.56	-0.98	-1.31	-2.30

DAVIDSON LABORATORY 31-JUL-80

SES BUOYANT SIDEWALL, LOAD TEST MODEL

RUN 69

SPEED 3.70 FPS WAVE ENCOUNTERS 102
DRAG 1.36 LB SIGNIFICANT WAVE HEIGHT 1.82 IN
LOAD 56.14 LB LCG 35.17 IN

	MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH DEG.	0.139	55	1.00	1.55	2.00	2.30
	0.681		-0.71	-1.23	-1.61	-1.81
HEAVE IN.	4.978	45	5.13	5.23		5.34
	0.108		4.83	4.75		4.68
SHEAR FWD LB	+0.983	211	-1.10	-2.97	-6.00	-39.02
	1.288		+2.90	+4.35	+6.36	+29.57
PM FWD LB-FT						
SHEAR AFT LB	-0.689	88	0.78	1.58	2.27	3.39
	1.064		-2.17	-3.02	-3.59	-4.48
PM AFT LB-FT	-0.694	76	0.74	1.46	2.07	2.98
	1.004		-2.13	-2.91	-3.57	-4.62
BOW ACC #1G	-0.009	39	0.15	0.22		0.32
	0.097		-0.18	-0.25		-0.33
BOW ACC #2G	-0.012	16	0.13	0.16		0.18
	0.062		-0.16	-0.20		-0.23
CG ACC #1 G	-0.007	16	0.11	0.15		0.18
	0.054		-0.14	-0.18		-0.19
CG ACC #2 G	-0.011	1	0.00			
	0.031		-0.12			
WAVE , IN.	0.141	103	0.67	1.07	1.35	1.47
	0.454		-0.36	-0.75	-0.98	-1.12

DAVIDSON LABORATORY 31-JUL-80

SES BUOYANT SIDEWALL, LOAD TEST MODEL

RUN 70

SPEED 4.94 FPS WAVE ENCOUNTERS 85
DRAG 2.85 LB SIGNIFICANT WAVE HEIGHT 1.82 IN
LOAD 56.14 LB LCG 35.17 IN

	MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH DEG.	0.255	42	1.11	1.69		2.00
	0.639		-0.58	-1.07		-1.43
HEAVE IN.	4.874	36	5.07	5.19		5.30
	0.135		4.69	4.56		4.39
SHEAR FWD LB	+0.579	55	-1.13	-1.68	-2.06	-2.70
	0.973		+2.31	+2.99	+3.34	+3.76
BM FWD LB-FT	-0.064	95	0.97	1.67	2.10	2.98
	0.780		-1.12	-1.83	-2.34	-3.23
SHEAR AFT LB	-1.481	96	-0.17	0.89	1.76	5.12
	1.067		-2.94	-3.82	-4.71	-6.59
BM AFT LB-FT	-1.791	69	-0.46	0.36	0.92	1.49
	0.937		-3.21	-3.96	-4.65	-5.67
BOW ACC #1G	-0.007	34	0.17	0.25		0.38
	0.107		-0.19	-0.28		-0.35
BOW ACC #2G	-0.011	19	0.14	0.18		0.24
	0.071		-0.17	-0.22		-0.24
CG ACC #1 G	-0.009	16	0.13	0.17		0.24
	0.063		-0.17	-0.20		-0.22
CG ACC #2 G	-0.011	1	0.11			
	0.034		-0.14			
WAVE , IN.	0.154	85	0.71	1.08	1.31	1.58
	0.440		-0.34	-0.73	-0.93	-1.10

DAVIDSON LABORATORY 31-JUL-80

SES BUOYANT SIDEWALL, LOAD TEST MODEL

RUN 71

SPEED 6.17 FPS WAVE ENCOUNTERS 78
DRAG 3.76 LB SIGNIFICANT WAVE HEIGHT 1.82 IN
LOAD 56.14 LB LCG 35.17 IN

	MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH DEG.	0.216	36	0.93	1.40		1.78
	0.535		-0.49	-0.88		-1.15
HEAVE IN.	4.822	29	5.01	5.13		5.17
	0.128		4.64	4.54		4.42
SHEAR FWD LB	-0.333	101	-2.08	-3.29	-4.67	-8.96
	1.195		+1.45	+2.49	+3.63	+9.33
BM FWD LB-FT	0.594	212	1.63	2.73	3.66	5.67
	1.047		-0.70	-1.91	-3.19	-6.27
SHEAR AFT LB	0.284	202	1.42	2.30	3.00	4.90
	1.028		-0.82	-1.72	-2.34	-3.24
BM AFT LB-FT	0.128	154	1.32	2.14	2.69	3.73
	0.887		-0.98	-2.10	-2.99	-4.25
BOW ACC #1G	-0.014	40	0.21	0.34		0.62
	0.105		-0.18	-0.27		-0.36
BOW ACC #2G	-0.011	23	0.16	0.23		0.31
	0.069		-0.15	-0.20		-0.25
CG ACC #1 G	-0.007	18	0.15	0.22		0.30
	0.062		-0.15	-0.18		-0.22
CG ACC #2 G	-0.011	3	0.11			0.12
	0.036		-0.11			-0.12
WAVE , IN.	0.183	77	0.77	1.26	1.63	2.08
	0.454		-0.32	-0.62	-0.81	-1.36

DAVIDSON LABORATORY 31-JUL-80

SES BUOYANT SIDEWALL, LOAD TEST MODEL

RUN 72

SPEED 7.40 FPS		WAVE ENCOUNTERS	73
DRAG 4.94 LB		SIGNIFICANT WAVE HEIGHT	1.82 IN
LOAD 56.14 LB		LCG	35.17 IN

	MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH DEG.	1.098	31	1.71	2.10		2.30
	0.462		0.48	0.15		-0.12
HEAVE IN.	4.762	27	4.94	5.05		5.11
	0.128		4.59	4.48		4.40
SHEAR FWD LB	+0.158	66	-1.75	-3.13	-5.46	-13.40
	1.211		+2.07	+2.92	+3.63	+5.17
BM FWD LB-FT	-0.345	136	1.07	2.53	4.02	6.86
	1.230		-1.89	-3.37	-5.27	-8.92
SHEAR AFT LB	-0.047	131	1.12	2.05	2.79	5.22
	1.002		-1.17	-2.11	-2.82	-3.88
BM AFT LB-FT	0.086	102	1.38	2.35	3.12	5.34
	0.910		-1.10	-2.18	-3.19	-4.10
BOW ACC #1G	-0.018	38	0.18	0.33		0.60
	0.105		-0.21	-0.33		-0.52
BOW ACC #2G	-0.012	22	0.15	0.21		0.41
	0.068		-0.15	-0.19		-0.21
CG ACC #1 G	-0.008	14	0.15			0.39
	0.062		-0.14			-0.17
CG ACC #2 G	-0.015	3	0.10			0.11
	0.033		-0.12			-0.14
WAVE , IN.	0.173	72	0.77	1.21	1.51	2.06
	0.467		-0.33	-0.72	-1.06	-1.79

DAVIDSON LABORATORY 31-JUL-80

SES BUOYANT SIDEWALL, LOAD TEST MODEL

RUN 73

SPEED 2.47 FPS WAVE ENCOUNTERS 104
DRAG 0.65 LB SIGNIFICANT WAVE HEIGHT 2.75 IN
LOAD 56.14 LB LCG 35.17 IN

	MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH DEG.	0.161	72	1.64	2.61	3.16	3.94
	1.221		-1.30	-2.32	-3.01	-3.38
HEAVE IN.	4.981	51	5.35	5.69	5.84	5.97
	0.298		4.61	4.34	4.17	4.02
SHEAR FWD LB	+0.585	86	-1.81	-3.02	-3.84	
	1.511		+2.90	+4.42	+6.13	
BM FWD LB-FT	-0.335	113	1.23	2.45	3.83	
	1.098		-1.70	-2.64	-3.12	
SHEAR AFT LB	-0.320	109	1.66	3.32	4.16	5.83
	1.728		-2.31	-3.84	-4.96	-6.31
BM AFT LB-FT	-0.364	97	1.93	3.45	4.42	5.54
	1.718		-2.11	-3.87	-4.93	-6.25
BOW ACC #1G	-0.010	57	0.18	0.28	0.39	0.66
	0.116		-0.20	-0.27	-0.32	-0.38
BOW ACC #2G	-0.012	38	0.14	0.21		0.49
	0.075		-0.16	-0.20		-0.27
CG ACC #1 G	-0.007	28	0.14	0.20		0.40
	0.065		-0.15	-0.18		-0.23
CG ACC #2 G	-0.013	8	0.10			0.13
	0.044		-0.13			-0.15
WAVE , IN.	-0.013	105	0.83	1.40	1.85	2.65
	0.717		-0.72	-1.38	-1.84	-2.45

DAVIDSON LABORATORY 31-JUL-80

SES BUOYANT SIDEWALL, LOAD TEST MODEL

RUN 74

SPEED 3.70 FPS		WAVE ENCOUNTERS	82
DRAG 1.58 LB		SIGNIFICANT WAVE HEIGHT	2.75 IN
LOAD 56.14 LB		LCG	35.17 IN

	MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH DEG.	0.242	52	1.93	2.88	3.37	3.59
	1.362		-1.45	-2.41	-2.91	-3.27
HEAVE IN.	4.939	45	5.32	5.59		5.86
	0.311		4.55	4.32		4.01
SHEAR FWD LB	+0.372	60	-1.81	-2.73	-3.26	-4.07
	1.356		+2.65	+3.52	+4.18	+5.03
PM FWD LB-FT	-0.071	76	1.20	1.89	2.53	3.69
	0.860		-1.45	-2.18	-2.51	-2.85
SHEAR AFT LB	-0.216	76	1.85	3.37	4.62	
	1.652		-2.50	-3.94	-5.11	
PM AFT LB-FT	-0.289	63	1.82	3.04	3.77	4.54
	1.609		-2.45	-3.60	-4.15	-4.94
BOW ACC #1G	-0.014	49	0.22	0.31		0.37
	0.158		-0.25	-0.34		-0.42
BOW ACC #2G	-0.012	38	0.16	0.21		0.24
	0.102		-0.19	-0.24		-0.28
CG ACC #1 G	-0.008	36	0.15	0.19		0.22
	0.090		-0.17	-0.21		-0.25
CG ACC #2 G	-0.013	11	0.10			0.12
	0.052		-0.14			-0.18
WAVE , IN.	0.130	82	0.94	1.51	1.89	2.72
	0.655		-0.50	-1.09	-1.36	-1.60

DAVIDSON LABORATORY 31-JUL-80

SES BUOYANT SIDEWALL, LOAD TEST MODEL

RUN 75

SPEED 4.94 FPS WAVE ENCOUNTERS 70
DRAG 3.09 LB SIGNIFICANT WAVE HEIGHT 2.75 IN
LOAD 56.14 LB LCG 35.17 IN

	MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH DEG.	0.433	40	2.12	2.93		3.55
	1.327		-1.29	-2.21		-3.18
HEAVE IN.	4.867	38	5.31	5.63		5.93
	0.387		4.42	4.09		3.87
SHEAR FWD LB	+0.250	57	-1.98	-3.10	-4.53	-5.89
	1.268		+2.26	+3.24	+3.98	+5.01
FM FWD LB-FT	0.041	114	1.48	3.28	5.95	20.06
	1.179		-1.53	-2.89	-4.03	-6.38
SHEAR AFT LB	-1.426	96	0.47	2.23	3.91	9.81
	1.507		-3.01	-4.54	-5.75	-9.04
FM AFT LB-FT	-1.600	97	0.10	1.68	2.80	4.60
	1.392		-3.00	-4.45	-5.33	-7.41
BOW ACC #1G	-0.023	44	0.28	0.46		0.93
	0.194		-0.31	-0.42		-0.50
BOW ACC #2G	-0.011	39	0.21	0.34		0.66
	0.129		-0.22	-0.29		-0.33
CG ACC #1 G	-0.008	35	0.21	0.32		0.55
	0.117		-0.21	-0.27		-0.30
CG ACC #2 G	-0.015	17	0.12	0.15		0.16
	0.063		-0.15	-0.17		-0.20
WAVE , IN.	0.165	70	0.92	1.49	1.86	2.44
	0.654		-0.50	-1.07	-1.35	-1.55

DAVIDSON LABORATORY 4-AUG-80

SES BUOYANT SIDEWALL, LOAD TEST MODEL

RUN 115

SPEED 1.23 FPS
DRAG 0.03 LB
LOAD 77.14 LB

WAVE ENCOUNTERS 256
SIGNIFICANT WAVE HEIGHT 0.98 IN
LCG 40.35 IN

	MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH DEG.	-1.047	133	-0.80	-0.69	-0.54	0.59
	0.130		-1.28	-1.37	-1.44	-1.52
HEAVE IN.	4.014	2	4.07			4.07
	0.015		3.96			3.95
SHEAR FWD LB	-0.047	213	-1.44	-1.95	-2.42	
	0.651		+1.45	+2.20	+3.70	
BM FWD LB-FT	0.082	981	0.86	1.28	1.66	3.64
	0.508		-0.71	-1.13	-1.54	-16.61
SHEAR AFT LB	-0.162	703	0.66	1.15	1.49	
	0.567		-0.99	-1.52	-1.99	
BM AFT LB-FT	-0.381	261	0.60	0.99	1.31	2.61
	0.465		-1.43	-1.83	-2.21	-4.55
BOW ACC #1G	-0.014	3	0.06			0.11
	0.024		-0.14			-0.16
BOW ACC #2G	-0.012	0	0.00	0.00	0.00	0.00
	0.015		0.00	0.00	0.00	0.00
CG ACC #1 G	-0.005	0	0.00	0.00	0.00	0.00
	0.014		0.00	0.00	0.00	0.00
CG ACC #2 G	-0.006	0	0.00	0.00	0.00	0.00
	0.015		0.00	0.00	0.00	0.00
WAVE , IN.	-0.267	256	0.17	0.44	0.68	1.33
	0.300		-0.63	-0.81	-0.96	-1.15

DAVIDSON LABORATORY 4-AUG-80

SES BUOYANT SIDEWALL, LOAD TEST MODEL

RUN 116

SPEED 2.47 FPS
DRAG 0.47 LB
LOAD 77.14 LB

WAVE ENCOUNTERS 170
SIGNIFICANT WAVE HEIGHT 0.98 IN
LCG 40.35 IN

	MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH DEG.	-1.028	75	-0.80	-0.71	-0.67	-0.59
	0.133		-1.26	-1.35	-1.43	-1.49
HEAVE IN.	3.994	4	4.04			4.06
	0.019		3.93			3.93
SHEAR FWD LB	+0.439	400	-1.09	-1.74	-2.27	-3.77
	0.788		+2.02	+2.66	+3.26	+6.33
PM FWD LB-FT	-0.259	1000	0.77	1.40	1.94	3.84
	0.747		-1.29	-1.96	-2.50	-5.26
SHEAR AFT LB	-0.710	760	0.26	0.90	1.33	2.98
	0.692		-1.71	-2.36	-2.85	-6.08
PM AFT LB-FT	-0.706	651	0.48	1.06	1.48	2.48
	0.699		-1.93	-2.49	-2.94	-4.14
BOW ACC #1G	-0.010	41	0.11	0.14		0.20
	0.036		-0.13	-0.17		-0.19
BOW ACC #2G	-0.013	0	0.00	0.00	0.00	0.00
	0.016		0.00	0.00	0.00	0.00
CG ACC #1 G	-0.005	0	0.00	0.00	0.00	0.00
	0.016		0.00	0.00	0.00	0.00
CG ACC #2 G	-0.006	0	0.00	0.00	0.00	0.00
	0.015		0.00	0.00	0.00	0.00
WAVE , IN.	0.056	169	0.44	0.66	0.87	1.22
	0.279		-0.30	-0.55	-0.74	-1.36

DAVIDSON LA*ORATORY 5-AUG-80

SES BUOYANT SIDEWALL, LOAD TEST MODEL

RUN 117

SPEED	3.70 FPS	WAVE ENCOUNTERS	132
DRAG	1.67 LB	SIGNIFICANT WAVE HEIGHT	0.98 IN
LOAD	77.14 LB	LCG	40.35 IN

	MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH DEG.	-1.038	55	-0.79	-0.70	-0.61	-0.29
	0.132		-1.27	-1.37	-1.43	-1.45
HEAVE IN.	3.857	11	3.92			3.94
	0.021		3.80			3.78
SHEAR FWD LB	+0.959	348	-0.67	-1.40	-1.96	- 3.35
	0.910		+2.66	+3.37	+4.09	+14.01
BM FWD LB-FT	-0.586	1000	0.63	1.41	2.03	2.99
	0.936		-1.81	-2.57	-3.22	-5.86
SHEAR AFT LB	-0.807	692	0.22	0.93	1.45	2.49
	0.761		-1.86	-2.55	-3.02	-5.65
BM AFT LB-FT	-1.490	750	-0.25	0.33	0.78	1.61
	0.805		-2.71	-3.29	-3.72	-4.82
BOW ACC #1G	-0.010	123	0.11	0.13	0.15	0.16
	0.047		-0.13	-0.16	-0.17	-0.21
BOW ACC #2G	-0.014	0	0.00	0.00	0.00	0.00
	0.020		0.00	0.00	0.00	0.00
CG ACC #1 G	-0.006	0	0.00	0.00	0.00	0.00
	0.019		0.00	0.00	0.00	0.00
CG ACC #2 G	-0.009	0	0.00	0.00	0.00	0.00
	0.018		0.00	0.00	0.00	0.00
WAVE , IN.	0.055	133	0.39	0.60	0.76	1.02
	0.242		-0.26	-0.45	-0.63	-1.01

DAVIDSON LABORATORY 5-AUG-80

SES BUOYANT SIDEWALL, LOAD TEST MODEL

RUN 118

SPEED 4.94 FPS	WAVE ENCOUNTERS	112	
DRAG 3.38 LB	SIGNIFICANT WAVE HEIGHT	0.98	IN
LOAD 77.14 LB	LCG	40.35	IN

	MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH DEG.	-1.000	44	-0.81	-0.72		-0.61
	0.114		-1.20	-1.28		-1.32
HEAVE IN.	3.756	21	3.83	3.85		3.87
	0.034		3.69	3.66		3.65
SHEAR FWD LB	+0.682	367	-1.11	-1.88	-2.44	
	1.118		+2.45	+3.31	+4.30	
BM FWD LB-FT	-0.078	751	1.18	1.99	2.52	3.79
	0.980		-1.31	-2.08	-2.67	-4.01
SHEAR AFT LB	-2.657	485	-1.51	-0.90	-0.48	0.48
	0.798		-3.75	-4.42	-4.87	-5.63
BM AFT LB-FT	-2.707	411	-1.47	-0.94	-0.61	0.11
	0.730		-3.91	-4.47	-4.88	-5.62
BOW ACC #1G	0.011	62	0.14	0.17	0.21	0.30
	0.050		-0.11	-0.14	-0.16	-0.19
BOW ACC #2G	-0.014	0	0.00	0.00	0.00	0.00
	0.025		0.00	0.00	0.00	0.00
CG ACC #1 G	-0.008	2	0.08			0.17
	0.026		-0.09			-0.09
CG ACC #2 G	-0.011	0	0.00	0.00	0.00	0.00
	0.021		0.00	0.00	0.00	0.00
WAVE , IN.	0.092	111	0.42	0.60	0.69	0.79
	0.245		-0.22	-0.41	-0.51	-0.64

DAVIDSON LABORATORY 5-AUG-80

SES BUOYANT SIDEWALL, LOAD TEST MODEL

RUN 119

SPEED 6.17 FPS
DRAG 5.02 LB
LOAD 77.14 LB

WAVE ENCOUNTERS 100
SIGNIFICANT WAVE HEIGHT 0.98 IN
LCG 40.35 IN

	MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH DEG.	-1.223	44	-1.03	-0.96		-0.93
	0.104		-1.42	-1.49		-1.54
HEAVE IN.	3.656	5	3.74			3.78
	0.026		3.60			3.59
SHEAR FWD LB	-2.743	362	-5.47	-8.13	-11.69	
	2.042		-0.46	+0.73	+1.80	
BM FWD LB-FT	2.772	555	4.86	7.81	12.19	19.08
	2.339		0.59	-0.75	-1.98	-3.92
SHEAR AFT LB	1.344	452	3.05	4.94	7.47	12.06
	1.510		-0.26	-1.12	-1.75	-3.51
BM AFT LB-FT	0.617	423	2.44	4.10	6.12	9.57
	1.336		-1.03	-1.79	-2.43	-3.83
BOW ACC #1G	0.013	155	0.21	0.35	0.48	0.61
	0.089		-0.13	-0.19	-0.23	-0.28
BOW ACC #2G	-0.013	45	0.17	0.23		0.27
	0.051		-0.11	-0.13		-0.18
CG ACC #1 G	-0.008	47	0.21	0.29		0.40
	0.051		-0.09	-0.11		-0.15
CG ACC #2 G	-0.013	1	0.00			
	0.028		-0.12			
WAVE , IN.	0.102	100	0.44	0.64	0.82	0.94
	0.244		-0.20	-0.37	-0.48	-0.66

DAVIDSON LABORATORY 5-AUG-80

SES BUOYANT SIDEWALL, LOAD TEST MODEL

RUN 120

SPEED	7.40 FPS	WAVE ENCOUNTERS	90
DRAG	7.04 LB	SIGNIFICANT WAVE HEIGHT	0.98 IN
LOAD	77.14 LB	LCG	40.35 IN

	MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH DEG.	0.102	34	0.29	0.38		0.44
	0.110		-0.11	-0.19		-0.25
HEAVE IN.	3.542	21	3.60	3.64		3.68
	0.040		3.46	3.43		3.41
SHEAR FWD LB	-3.453	333	-6.11	-9.25	-13.03	-25.44
	2.455		-0.85	+0.44	+1.37	+6.94
BM FWD LB-FT	2.403	448	4.14	6.17	8.95	23.73
	1.806		0.59	-0.59	-1.97	-8.96
SHEAR AFT LB	2.889	418	4.47	6.17	8.17	19.51
	1.549		1.27	0.27	-0.72	-4.48
BM AFT LB-FT	3.073	494	4.71	6.15	7.94	15.78
	1.510		1.34	0.35	-0.73	-6.16
BOW ACC #1G	0.004	137	0.23	0.42	0.59	0.95
	0.119		-0.18	-0.27	-0.36	-0.44
BOW ACC #2G	-0.012	45	0.18	0.27		0.44
	0.065		-0.13	-0.16		-0.23
CG ACC #1 G	-0.009	51	0.23	0.35	0.49	0.64
	0.070		-0.12	-0.15	-0.21	-0.35
CG ACC #2 G	-0.011	4	0.10			0.13
	0.026		-0.12			-0.13
WAVE , IN.	0.099	90	0.42	0.61	0.76	0.94
	0.240		-0.21	-0.38	-0.50	-0.66

DAVIDSON LABORATORY 5-AUG-80

SES BUOYANT SIDEWALL, LOAD TEST MODEL

RUN 121

SPEED 1.23 FPS WAVE ENCOUNTERS 194
DRAG 0.04 LB SIGNIFICANT WAVE HEIGHT 1.82 IN
LOAD 77.14 LB LCG 40.35 IN

	MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH DEG.	-1.095	135	-0.49	-0.16	0.10	0.49
	0.455		-1.68	-2.07	-2.36	-2.64
HEAVE IN.	3.962	97	4.10	4.18	4.23	4.30
	0.089		3.82	3.75	3.69	3.58
SHEAR FWD LB	-0.073	292	-2.26	-3.65	-4.88	-8.26
	1.341		+1.66	+3.34	+5.09	+16.03
PM FWD LB-FT	0.060	1000	1.11	2.17	3.03	14.85
	1.059		-0.74	-1.74	-2.42	-4.62
SHEAR AFT LB	-0.359	899	0.79	2.13	3.15	6.64
	1.252		-1.13	-2.49	-3.45	-8.23
PM AFT LB-FT						
BOW ACC #1G	-0.015	72	0.12	0.17	0.21	0.33
	0.047		-0.15	-0.20	-0.24	-0.27
BOW ACC #2G	-0.016	6	0.13			0.26
	0.029		-0.11			-0.13
CG ACC #1 G	-0.006	3	0.11			0.19
	0.026		-0.10			-0.10
CG ACC #2 G	-0.008	2	0.54			
	0.023		-0.27			
WAVE , IN.	-0.404	194	0.29	0.75	1.07	1.53
	0.517		-1.00	-1.34	-1.57	-1.95

DAVIDSON LABORATORY 5-AUG-80

SES BUOYANT SIDEWALL, LOAD TEST MODEL

RUN 122

SPEED 2.47 FPS WAVE ENCOUNTERS 122
DRAG 0.54 LB SIGNIFICANT WAVE HEIGHT 1.82 IN
LOAD 77.14 LB LCG 40.35 IN

	MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH DEG.	-1.084	76	-0.39	0.01	0.25	0.49
	0.546		-1.79	-2.24	-2.54	-2.91
HEAVE IN.	3.944	57	4.09	4.17	4.21	4.30
	0.096		3.80	3.72	3.66	3.60
SHEAR FWD LB	+0.448	449	-1.30	-2.67	-3.66	- 7.99
	1.382		+2.02	+3.39	+4.44	+12.78
FM FWD LB-FT	-0.135	1000	0.94	2.08	3.15	14.50
	1.187		-1.25	-2.33	-3.23	-13.90
SHEAR AFT LB	-0.585	801	0.54	1.88	2.85	5.67
	1.242		-1.56	-2.83	-3.51	-4.70
FM AFT LB-FT						
BOW ACC #1G	-0.012	86	0.14	0.22	0.31	0.48
	0.070		-0.15	-0.20	-0.22	-0.26
BOW ACC #2G	-0.016	12	0.15			0.36
	0.041		-0.13			-0.16
CG ACC #1 G	-0.009	8	0.16			0.31
	0.037		-0.12			-0.14
CG ACC #2 G	-0.010	2	0.05			0.09
	0.026		-0.15			-0.18
WAVE , IN.	-0.104	123	0.53	0.88	1.12	1.51
	0.500		-0.68	-1.05	-1.30	-1.77

DAVIDSON LABORATORY 5-AUG-80

SES BUOYANT SIDEWALL, LOAD TEST MODEL

RUN 123

SPEED 3.70 FPS WAVE ENCOUNTERS 98
DRAG SIGNIFICANT WAVE HEIGHT 1.82 IN
LOAD 77.14 LB LCG 40.35 IN

	MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH DEG.	-1.104	57	-0.38	0.06	0.28	0.86
	0.548		-1.81	-2.27	-2.49	-2.60
HEAVE IN.	3.865	42	4.02	4.12		4.20
	0.102		3.72	3.65		3.55
SHEAR FWD LB	+0.960	409	-0.91	-2.27	-3.32	-6.94
	1.489		+2.82	+4.09	+4.88	+9.78
BM FWD LB-FT	-0.585	866	0.73	1.95	3.23	14.78
	1.335		-1.97	-3.07	-3.87	-10.15
SHEAR AFT LB	-0.897	577	0.37	1.65	2.52	4.21
	1.274		-2.16	-3.35	-4.15	-6.80
BM AFT LB-FT	-1.070	494	0.40	1.57	2.26	3.65
	1.219		-2.43	-3.56	-4.23	-5.20
BOW ACC #1G	-0.010	98	0.16	0.24	0.34	0.47
	0.088		-0.16	-0.22	-0.26	-0.29
BOW ACC #2G	-0.011	24	0.15	0.22		0.32
	0.052		-0.13	-0.15		-0.17
CG ACC #1 G	-0.006	24	0.14	0.20		0.26
	0.047		-0.12	-0.14		-0.16
CG ACC #2 G	-0.010	5	0.16			0.43
	0.035		-0.14			-0.22
WAVE , IN.	0.038	98	0.60	0.99	1.28	1.45
	0.455		-0.46	-0.83	-1.06	-1.62

DAVIDSON LABORATORY 5-AUG-80

SES BUOYANT SIDEWALL, LOAD TEST MODEL

RUN 124

SPEED 3.70 FPS WAVE ENCOUNTERS 97
DRAG 1.61 LB SIGNIFICANT WAVE HEIGHT 1.82 IN
LOAD 77.14 LB LCG 40.35 IN

	MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH DEG.	-1.123	59	-0.41	0.04	0.45	1.33
	0.550		-1.87	-2.28	-2.49	-2.68
HEAVE IN.	3.876	41	4.04	4.13		4.25
	0.103		3.73	3.66		3.56
SHEAR FWD LB	+0.685	426	-1.28	-2.75	-3.73	-6.73
	1.529		+2.58	+3.95	+4.88	+7.51
BM FWD LB-FT	-0.382	855	1.01	2.38	3.95	19.05
	1.403		-1.82	-3.01	-3.88	-7.76
SHEAR AFT LB	-0.814	608	0.53	1.86	2.81	7.10
	1.303		-2.06	-3.29	-4.09	-5.41
BM AFT LB-FT	-0.992	508	0.60	1.78	2.57	4.76
	1.239		-2.31	-3.44	-4.10	-5.40
BOW ACC #1G	-0.009	110	0.17	0.28	0.40	0.62
	0.090		-0.16	-0.23	-0.28	-0.35
BOW ACC #2G	-0.014	25	0.16	0.24		0.29
	0.053		-0.13	-0.16		-0.18
CG ACC #1 G	-0.007	23	0.16	0.24		0.35
	0.048		-0.12	-0.15		-0.17
CG ACC #2 G	-0.010	3	0.10			0.11
	0.034		-0.12			-0.13
WAVE , IN.	0.046	97	0.63	1.04	1.42	1.73
	0.465		-0.47	-0.81	-1.04	-1.35

DAVIDSON LABORATORY 5-AUG-80

SES BUOYANT SIDEWALL, LOAD TEST MODEL

RUN 125

SPEED 4.94 FPS WAVE ENCOUNTERS 78
DRAG 3.64 LB SIGNIFICANT WAVE HEIGHT 1.82 IN
LOAD 77.14 LB LCG 40.35 IN

	MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH DEG.	-0.767	41	-0.25	0.02		0.42
	0.382		-1.30	-1.63		-1.93
HEAVE IN.	3.943	33	4.10	4.17		4.23
	0.099		3.81	3.74		3.64
SHEAR FWD LB	+0.889	448	-1.15	-2.76	-4.19	-10.31
	1.731		+2.93	+4.49	+5.90	+15.81
PM FWD LB-FT	-0.152	761	1.40	3.11	5.36	21.28
	1.976		-1.73	-3.15	-4.43	-7.53
SHEAR AFT LB	-2.531	561	-1.17	0.22	1.54	8.51
	1.440		-3.83	-5.15	-6.15	-8.38
PM AFT LB-FT	-2.660	458	-1.16	0.04	1.05	6.88
	1.272		-4.13	-5.23	-6.06	-8.09
BOW ACC #1G	-0.006	117	0.19	0.34	0.50	0.85
	0.092		-0.15	-0.21	-0.24	-0.33
BOW ACC #2G	-0.012	27	0.18	0.28		0.45
	0.054		-0.12	-0.15		-0.18
CG ACC #1 G	-0.005	29	0.21	0.30		0.45
	0.051		-0.11	-0.14		-0.19
CG ACC #2 G	-0.009	6	0.09			0.13
	0.031		-0.13			-0.17
WAVE , IN.	0.189	79	0.74	1.17	1.44	1.77
	0.437		-0.33	-0.64	-0.78	-0.95

DAVIDSON LABORATORY 5-AUG-80

SES BUOYANT SIDEWALL, LOAD TEST MODEL

RUN 126

SPEED	6.17 FPS	WAVE ENCOUNTERS	73
DRAG	5.34 LB	SIGNIFICANT WAVE HEIGHT	1.82 IN
LOAD	77.14 LB	LCG	40.35 IN

	MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH DEG.	-1.357	41	-0.89	-0.58		1.06
	0.315		-1.82	-2.12		-2.36
HEAVE IN.	3.800	28	3.92	3.99		4.08
	0.085		3.68	3.60		3.53
SHEAR FWD LB	-2.712	382	-5.43	-9.01	-14.08	-30.16
	2.682		-0.35	+1.27	+2.39	+6.64
PM FWD LB-FT	3.228	468	5.72	11.50	20.68	65.28
	4.641		0.68	-1.79	-4.32	-19.74
SHEAR AFT LB	0.997	459	2.74	5.57	9.96	28.71
	2.313		-0.75	-2.09	-3.22	-6.13
PM AFT LB-FT	0.474	428	2.33	4.78	8.34	22.57
	2.003		-1.31	-2.58	-3.53	-6.40
BOW ACC #1G	-0.004	118	0.29	0.55	0.80	1.39
	0.125		-0.17	-0.27	-0.39	-0.63
BOW ACC #2G	-0.014	51	0.24	0.38	0.54	0.71
	0.076		-0.14	-0.20	-0.30	-0.47
CG ACC #1 G	-0.009	47	0.28	0.43		0.75
	0.070		-0.10	-0.13		-0.19
CG ACC #2 G	-0.010	11	0.11			0.15
	0.040		-0.21			-0.38
WAVE , IN.	0.176	73	0.72	1.07	1.38	2.08
	0.431		-0.31	-0.65	-0.88	-1.13

DAVIDSON LABORATORY 5-AUG-80

SES BUOYANT SIDEWALL, LOAD TEST MODEL

RUN 127

SPEED 2.47 FPS WAVE ENCOUNTERS 104
DRAG 0.83 LB SIGNIFICANT WAVE HEIGHT 2.75 IN
LOAD 77.14 LB LCG 40.35 IN

	MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH DEG.	-1.151	69	0.12	0.94	1.33	1.79
	1.074		-2.49	-3.35	-3.97	-4.15
HEAVE IN.	4.100	57	4.47	4.75	4.93	5.01
	0.290		3.76	3.52	3.39	3.23
SHEAR FWD LB	+0.325	465	-1.71	-3.98	-5.95	-12.75
	1.976		+1.90	+3.94	+5.42	+8.72
PM FWD LB-FT	-0.168	1000	1.16	2.99	5.06	24.98
	1.960		-1.36	-2.91	-3.98	-9.13
SHEAR AFT LB	-0.233	893	1.13	3.19	4.47	14.29
	1.903		-1.12	-3.12	-4.38	-7.24
PM AFT LB-FT	-0.231	764	1.51	3.56	4.93	12.01
	1.876		-1.26	-3.19	-4.39	-7.61
BOW ACC #1G	-0.011	127	0.19	0.33	0.52	0.79
	0.105		-0.17	-0.26	-0.31	-0.42
BOW ACC #2G	-0.015	41	0.20	0.35		0.66
	0.066		-0.15	-0.19		-0.23
CG ACC #1 G	-0.007	28	0.21	0.32		0.50
	0.058		-0.14	-0.17		-0.20
CG ACC #2 G	-0.011	16	0.15	0.25		
	0.045		-0.14	-0.17		
WAVE . IN.	0.019	104	0.88	1.51	1.95	2.50
	0.739		-0.72	-1.36	-1.83	-2.38

DAVIDSON LABORATORY 5-AUG-80

SES BUOYANT SIDEWALL, LOAD TEST MODEL

RUN 128

SPEED 3.70 FPS
DRAG 1.90 LB
LOAD 77.14 LB

WAVE ENCOUNTERS 70
SIGNIFICANT WAVE HEIGHT 2.75 IN
LCG 40.35 IN

	MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH DEG.	-1.148	51	0.17	0.90	1.24	1.57
	1.077		-2.52	-3.37	-3.74	-4.06
HEAVE IN.	4.028	41	4.40	4.67		4.88
	0.305		3.65	3.42		3.24
SHEAR FWD LB	+1.086	425	-1.22	-3.37	-4.94	-9.12
	2.068		+2.99	+5.09	+6.41	+8.51
PM FWD LB-FT	-0.815	837	0.80	3.02	6.25	26.88
	2.215		-2.53	-4.26	-5.97	-14.19
SHEAR AFT LB	-1.159	661	0.30	2.43	3.98	13.49
	1.939		-2.48	-4.38	-5.49	-7.20
PM AFT LB-FT	-1.188	493	0.60	2.64	4.11	10.94
	1.863		-2.69	-4.53	-5.60	-7.32
BOW ACC #1G	-0.006	122	0.21	0.43	0.63	1.01
	0.131		-0.19	-0.31	-0.37	-0.45
BOW ACC #2G	-0.014	50	0.21	0.35	0.48	0.54
	0.082		-0.17	-0.22	-0.24	-0.26
CG ACC #1 G	-0.008	44	0.20	0.33		0.52
	0.074		-0.15	-0.20		-0.23
CG ACC #2 G	-0.009	26	0.11	0.14		0.18
	0.057		-0.15	-0.18		-0.23
WAVE , IN.	0.151	70	1.00	1.45	1.82	2.33
	0.646		-0.58	-1.12	-1.47	-1.81

DAVIDSON LABORATORY 5-AUG-80

SES BUOYANT SIDEWALL, LOAD TEST MODEL

RUN 129

SPEED 4.94 FPS WAVE ENCOUNTERS 64
DRAG 3.81 LB SIGNIFICANT WAVE HEIGHT 2.75 IN
LOAD 77.14 LB LCG 40.35 IN

	MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH DEG.	-0.998	42	0.08	0.91		1.32
	0.971		-2.14	-2.94		-3.48
HEAVE IN.	3.928	30	4.33	4.56		4.96
	0.289		3.57	3.36		3.18
SHEAR FWD LB	+0.627	457	-1.73	-4.04	-6.05	-15.86
	2.289		+2.94	+4.98	+6.37	+12.42
PM FWD LB-FT	0.154	721	2.11	5.54	11.15	58.35
	3.632		-2.02	-4.41	-6.69	-24.60
SHEAR AFT LB	-2.318	579	-0.76	1.28	3.13	17.50
	1.977		-3.88	-5.79	-6.98	-10.88
PM AFT LB-FT	-2.495	491	-0.87	0.94	2.62	14.92
	1.783		-4.21	-5.84	-6.83	-9.15
BOW ACC #1G	-0.003	132	0.27	0.55	0.81	1.13
	0.154		-0.19	-0.32	-0.38	-0.50
BOW ACC #2G	-0.015	53	0.24	0.39	0.55	0.86
	0.096		-0.17	-0.23	-0.27	-0.34
CG ACC #1 G	-0.007	47	0.26	0.41		0.68
	0.087		-0.15	-0.20		-0.28
CG ACC #2 G	-0.011	27	0.11	0.15		0.21
	0.059		-0.16	-0.22		-0.26
WAVE , IN.	0.185	64	1.01	1.53	1.82	2.07
	0.664		-0.52	-1.01	-1.33	-1.76

TABLE 10

RUN DIRECTORY

Configuration 2 in Irregular Waves

Load 56.14 lb. LCG 40.44 inches

Significant Wave Height, inches	4.10	6.10	7.50
Speed, fps			
1.23	-	-	269
2.47	265	267	-

Load 77.14 lb. LCG 40.44 inches

Significant Wave Height, inches	4.10	6.10	7.50
Speed, fps			
1.23	-	-	272
2.47	-	277	-

15-SEP-80

DAVIDSON LABORATORY

SES BOUYANT SIDEWALL, LOAD TEST MODEL

RUN 265

SPEED 2.36 FPS
DRAG 0.83 LB
LOAD 56.14 LB

WAVE ENCOUNTERS 76
SIGNIFICANT WAVE HEIGHT 4.10 IN
LCG 40.44 IN

	MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH,DEG	-0.373	65	1.66	2.59	2.94	3.51
	1.663		-2.53	-3.73	-4.18	-4.45
HEAVE,PIVOT	4.810	51	5.60	5.99	6.26	6.39
	0.601		4.05	3.63	3.42	3.18
SHEAR FWD,LB	-0.227	177	-3.66	-6.75	-9.30	-15.30
	2.173		+1.38	+3.90	+4.80	+6.92
PM FWD,LB-FT	0.050	166	4.68	9.75	17.58	43.04
	2.105		-3.79	-7.20	-12.67	-24.23
SHEAR AFT,LB	-0.108	191	3.29	6.19	8.74	16.64
	2.100		-1.78	-4.24	-5.58	-11.01
PM AFT,LB-FT	0.182	350	4.29	8.03	11.42	22.57
	2.488		-2.65	-5.90	-8.46	-20.08
BOW ACC #1,G	-0.013	200	0.22	0.51	0.82	1.64
	0.182		-0.30	-0.51	-0.65	-0.82
BOW ACC #2,G	-0.024	119	0.25	0.48	0.76	1.40
	0.111		-0.23	-0.37	-0.58	-1.09
CG ACC #1,G	-0.003	57	0.22	0.37	0.51	0.76
	0.085		-0.15	-0.20	-0.26	-0.34
CG ACC #2,G	-0.011	26	0.12	0.15		0.18
	0.058		-0.14	-0.17		-0.24
HEAVE @ KNUC	2.689	64	4.37	5.23	5.64	6.02
	1.391		0.96	-0.12	-0.47	-0.66
WAVE @ KNUCK	0.249	76	1.49	2.28	2.85	3.91
	1.040		-0.94	-1.79	-2.25	-2.65

DAVIDSON LABORATORY 26-SEP-80

SES BUOYANT SIDEWALL, LOAD TEST MODEL

RUN 267 ,280,281

SPEED 2.44 FPS WAVE ENCOUNTERS 189
DRAG 1.20 LB SIGNIFICANT WAVE HEIGHT 6.10 IN
LOAD 56.14 LB LCG 40.44 IN

	MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH,DEG	-0.441	196	2.09	3.97	5.01	6.44
	2.438		-3.29	-5.40	-6.75	-8.89
HEAVE PIVOT	4.823	138	6.28	7.21	7.77	9.03
	1.140		3.52	2.68	2.19	1.32
SHEAR FWD,LB	-0.294	416	-8.10	-13.57	-18.57	-33.50
	2.934		+2.28	+5.25	+7.13	+11.91
PM FWD,LB-FT	0.107	548	12.90	27.35	45.25	93.10
	4.633		-10.36	-17.76	-26.33	-48.59
SHEAR AFT,LB	-0.553	545	7.27	12.74	17.93	32.28
	2.904		-4.08	-7.55	-11.48	-22.66
PM AFT,LB-FT	0.166	442	10.37	16.08	21.31	32.79
	3.242		-5.21	-9.19	-13.80	-25.20
BOW ACC #1,G	-0.016	502	0.48	0.87	1.35	2.56
	0.231		-0.39	-0.61	-0.76	-0.95
BOW ACC #2,G	-0.015	534	0.56	1.04	1.58	3.11
	0.203		-0.41	-0.72	-1.14	-2.49
CG ACC #1,G	-0.011	484	0.28	0.53	0.82	1.54
	0.133		-0.14	-0.28	-0.40	-0.62
CG ACC #2,G	-0.012	499	0.08	0.16	0.21	0.34
	0.089		-0.12	-0.27	-0.41	-0.87
WAVE @ KNUCK	0.391	191	2.42	3.88	4.99	8.34
	1.685		-1.32	-2.67	-3.45	-4.46
HEAVE KNUCKL	2.397	173	4.88	6.78	7.77	9.63
	2.189		-0.14	-1.62	-2.69	-4.27

DAVIDSON LABORATORY 25-SEP-90

SES BUOYANT SIDEWALL, LOAD TEST MODEL

RUN 269 ,282,283

SPEED 1.23 FPS WAVE ENCOUNTERS 318
DRAG 0.60 LB SIGNIFICANT WAVE HEIGHT 7.5 IN
LOAD 56.14 LB LCG 40.44 IN

	MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH,DEG	-0.333	316	2.86	5.03	6.52	8.38
	2.965		-4.02	-6.67	-8.36	-10.91
HEAVE PIVOT	4.868	246	6.63	7.83	8.72	10.17
	1.444		3.23	2.17	1.56	0.81
SHEAR FWD,LB	-0.884	888	-8.89	-14.04	-19.69	-39.23
	3.316		+1.24	+4.94	+6.89	+13.88
BM FWD,LB-FT	0.676	933	12.33	23.12	36.67	66.70
	3.789		-5.26	-11.28	-19.95	-45.46
SHEAR AFT,LB	-0.344	897	7.22	11.89	15.85	22.24
	3.150		-3.35	-7.00	-10.12	-19.26
BM AFT,LB-FT	0.327	998	8.60	13.56	17.50	24.75
	3.373		-3.96	-8.46	-13.75	-49.75
BOW ACC #1,G	-0.016	841	0.44	0.84	1.35	2.33
	0.198		-0.28	-0.47	-0.57	-0.81
BOW ACC #2,G	-0.019	891	0.44	0.84	1.32	2.19
	0.161		-0.29	-0.54	-0.91	-1.92
CG ACC #1,G	-0.018	901	0.24	0.46	0.75	1.29
	0.117		-0.12	-0.24	-0.34	-0.62
CG ACC #2,G	-0.011	871	0.08	0.14	0.22	0.30
	0.081		-0.11	-0.[illegible]	[illegible].38	-0.73
WAVE @ KNUCK	0.099	336	2.45	4.55	6.02	10.00
	2.115		-1.98	-3.50	-4.46	-5.73
HEAVE KNUCKL	2.402	297	5.40	7.61	9.19	11.33
	2.633		-0.61	-2.56	-3.74	-5.18

DAVIDSON LABORATORY 26-SEP-80

SES BUOYANT SIDEWALL, LOAD TEST MODEL

RUN 277 ,278,279

SPEED	2.45 FPS	WAVE ENCOUNTERS	194
DRAG	1.29 LB	SIGNIFICANT WAVE HEIGHT	6.10 IN
LOAD	77.14 LB	LCG	40.44 IN

	MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH,DEG	-0.266	185	2.17	3.99	5.03	6.85
	2.312		-2.98	-4.93	-6.34	-7.87
HEAVE PIVOT	4.123	133	5.57	6.39	7.05	7.65
	1.131		2.77	1.97	1.44	0.58
SHEAR FWD,LB	+0.090	494	-7.90	-13.17	-17.53	-29.34
	3.361		+2.67	+6.33	+9.16	+19.54
BM FWD,LB-FT	-0.410	652	11.66	23.96	38.08	73.74
	4.632		-7.82	-13.47	-19.07	-34.49
SHEAR AFT,LB	-0.692	607	6.87	11.80	16.68	33.63
	3.152		-3.83	-7.39	-10.51	-20.89
BM AFT,LB-FT	-0.182	565	8.65	13.81	18.96	30.50
	3.439		-4.96	-9.01	-13.04	-22.14
BOW ACC #1,G	-0.022	455	0.45	0.83	1.22	2.17
	0.203		-0.35	-0.55	-0.69	-1.07
BOW ACC #2,G	-0.021	562	0.46	0.80	1.18	1.99
	0.172		-0.34	-0.56	-0.87	-1.61
CG ACC #1,G	-0.014	499	0.25	0.45	0.66	1.12
	0.118		-0.12	-0.23	-0.32	-0.50
CG ACC #2,G	-0.012	499	0.06	0.14	0.17	0.26
	0.080		-0.11	-0.22	-0.33	-0.78
WAVE @ KNUCK	0.724	198	2.60	3.99	4.99	6.38
	1.679		-1.00	-2.48	-3.26	-5.73
HEAVE KNUCKL	1.460	163	3.94	5.60	6.71	8.21
	2.079		-0.95	-2.46	-3.37	-4.85

DAVIDSON LABORATORY

26-SEP-80

SES BUOYANT SIDEWALL, LOAD TEST MODEL

RUN 272 ,274,275

SPEED 1.26 FPS
DRAG 0.65 LB
LOAD 77.14 LB

WAVE ENCOUNTERS 311
SIGNIFICANT WAVE HEIGHT 7.5 IN
LCG 40.44 IN

	MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH,DEG	-0.270	318	2.63	4.92	6.28	7.98
	2.766		-3.47	-5.87	-7.42	-9.81
HEAVE PIVOT	4.184	230	5.90	7.00	7.63	8.76
	1.393		2.57	1.50	0.85	0.21
SHEAR FWD,LB	-0.623	858	-9.01	-13.66	-19.19	-43.21
	3.609		+1.56	+5.77	+8.31	+26.22
PM FWD,LB-FT	0.121	950	12.23	21.39	31.77	57.32
	3.908		-4.69	-8.81	-13.54	-25.51
SHEAR AFT,LB	0.019	962	7.61	11.41	15.03	23.86
	3.656		-2.56	-6.45	-9.47	-48.78
PM AFT,LB-FT	0.064	810	9.27	13.16	16.79	25.80
	3.615		-4.59	-8.71	-12.91	-36.94
BOW ACC #1,G	-0.018	945	0.37	0.72	1.12	2.08
	0.180		-0.24	-0.42	-0.53	-0.65
BOW ACC #2,G	-0.022	959	0.38	0.67	0.98	1.78
	0.142		-0.24	-0.41	-0.62	-1.39
CG ACC #1,G	-0.017	854	0.22	0.41	0.65	1.15
	0.105		-0.10	-0.21	-0.28	-0.46
CG ACC #2,G	-0.010	866	0.06	0.13	0.17	0.32
	0.072		-0.10	-0.21	-0.31	-0.57
WAVE @ KNUCK	0.098	324	2.48	4.50	5.86	10.40
	2.078		-1.87	-3.52	-4.54	-6.23
HEAVE KNUCKL	1.630	281	4.53	6.54	7.89	9.48
	2.484		-1.19	-3.08	-4.17	-6.15

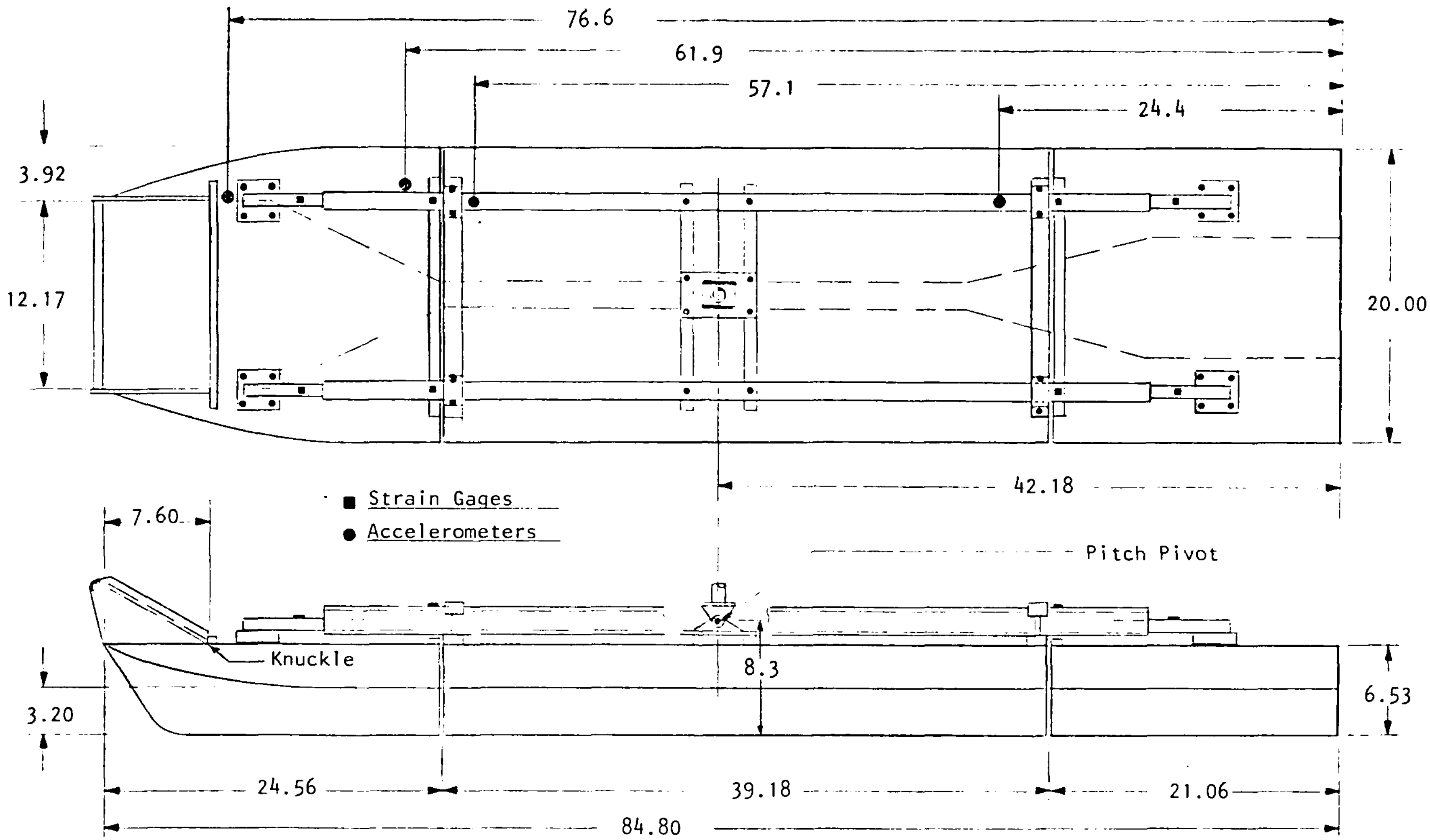


FIGURE 1 PRINCIPLE DIMENSIONS OF BUOYANT SIDEWALL SES MODEL

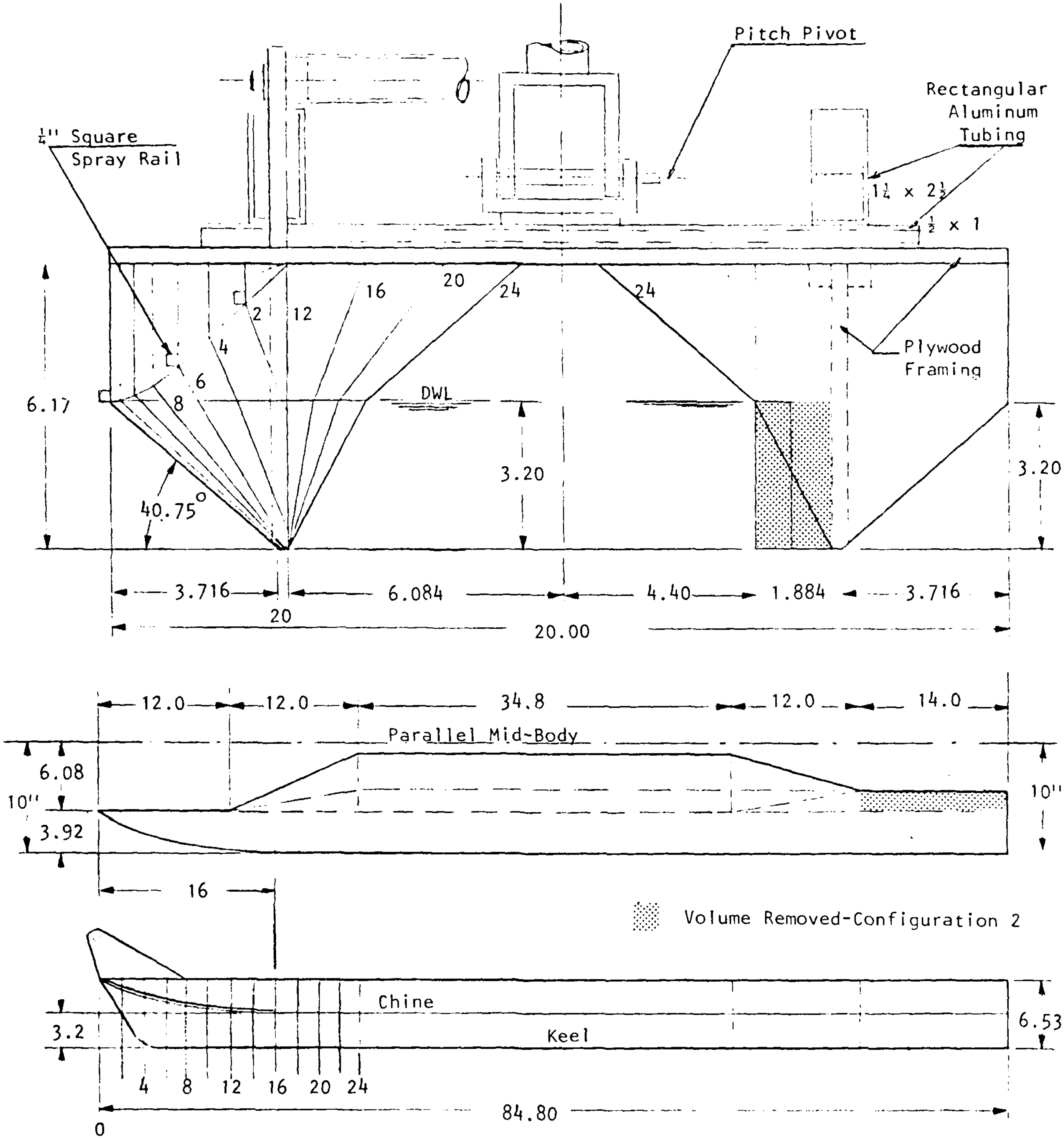


FIGURE 2 SIDEWALL LINES PLAN

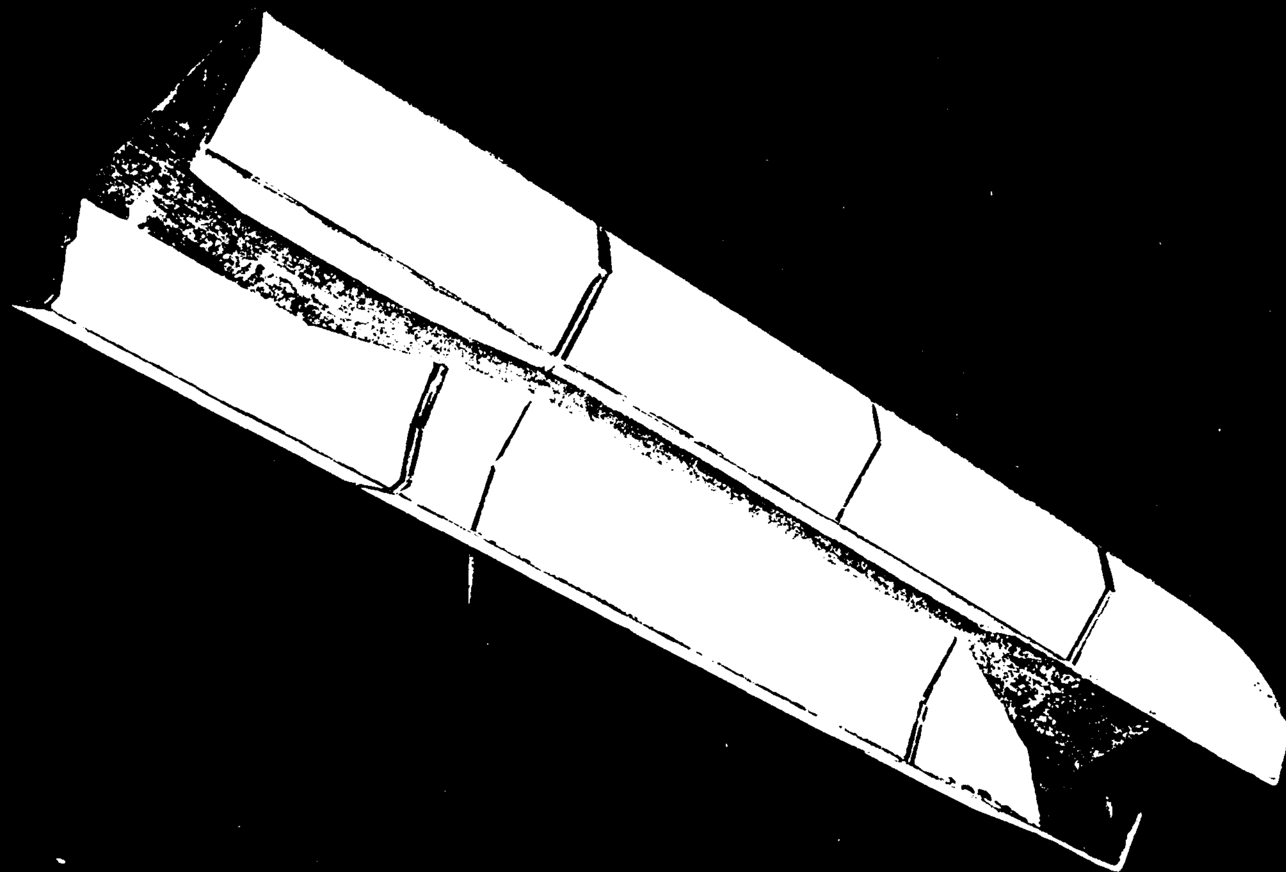


FIGURE 3- BOTTOM VIEW OF SIDEWALLS SHOWING DETAILS OF PLYWOOD AND FOAM CONSTRUCTION

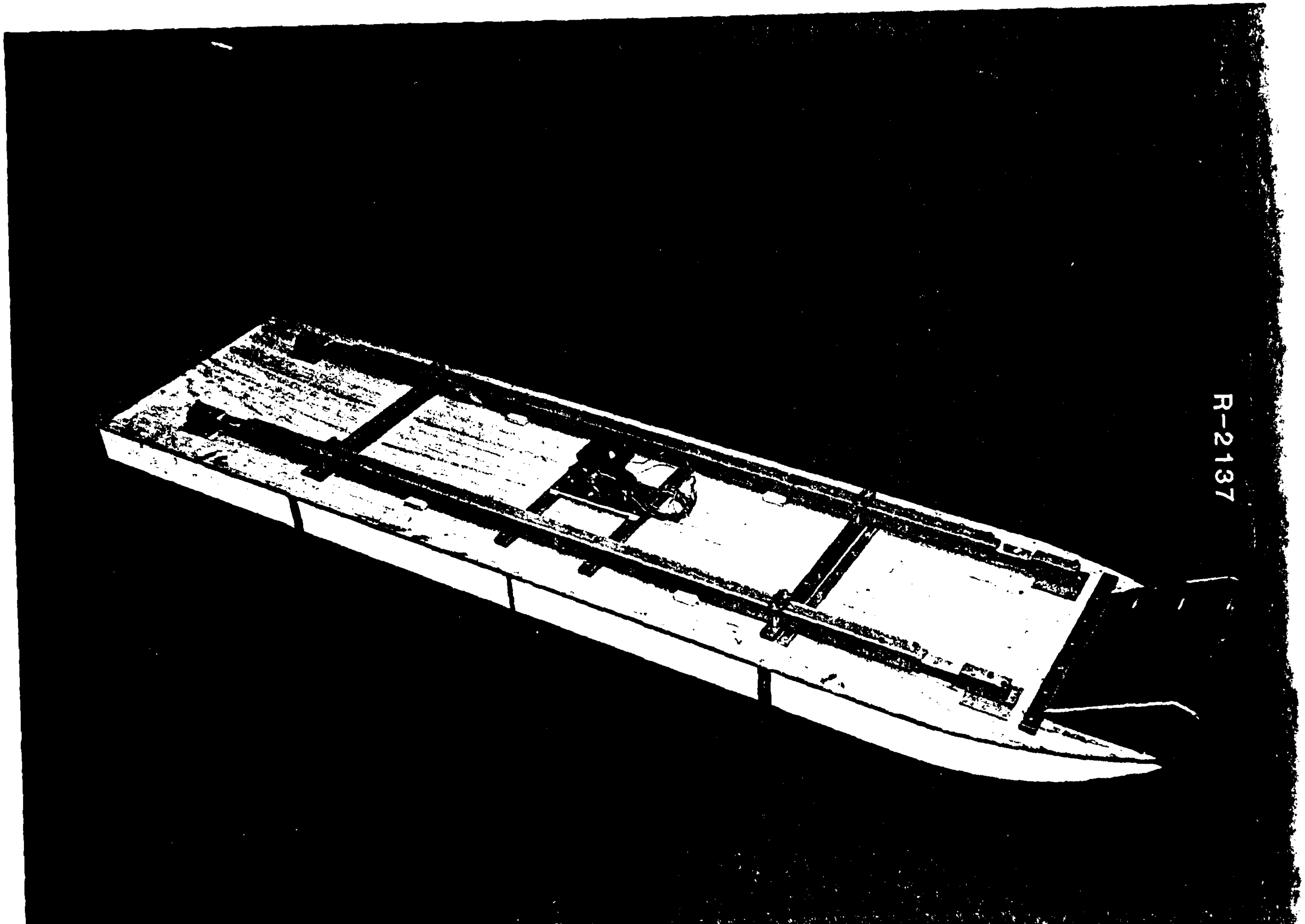


FIGURE 4– TOP VIEW OF MODEL SHOWING SUPPORT FRAME ASSEMBLY

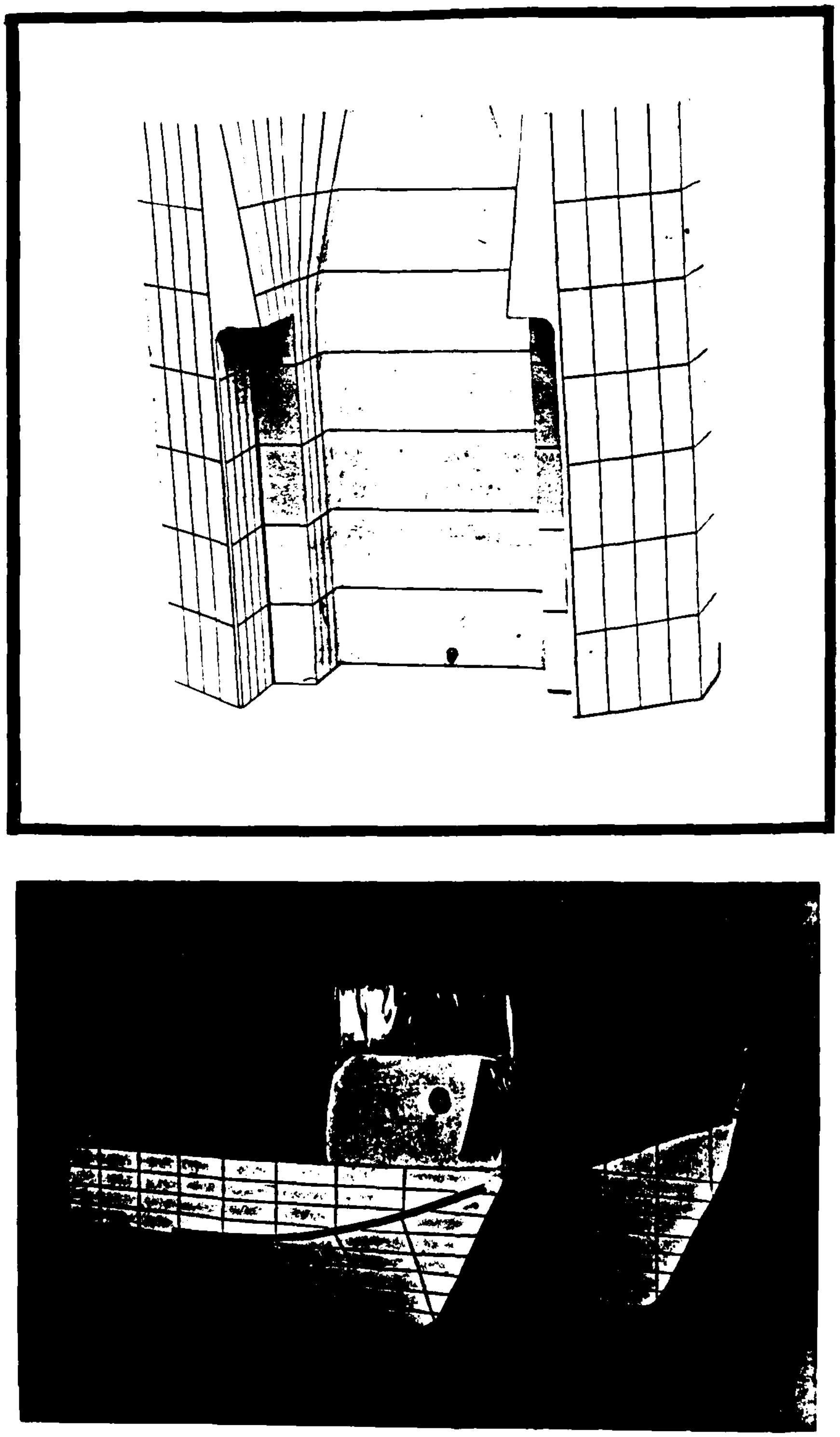
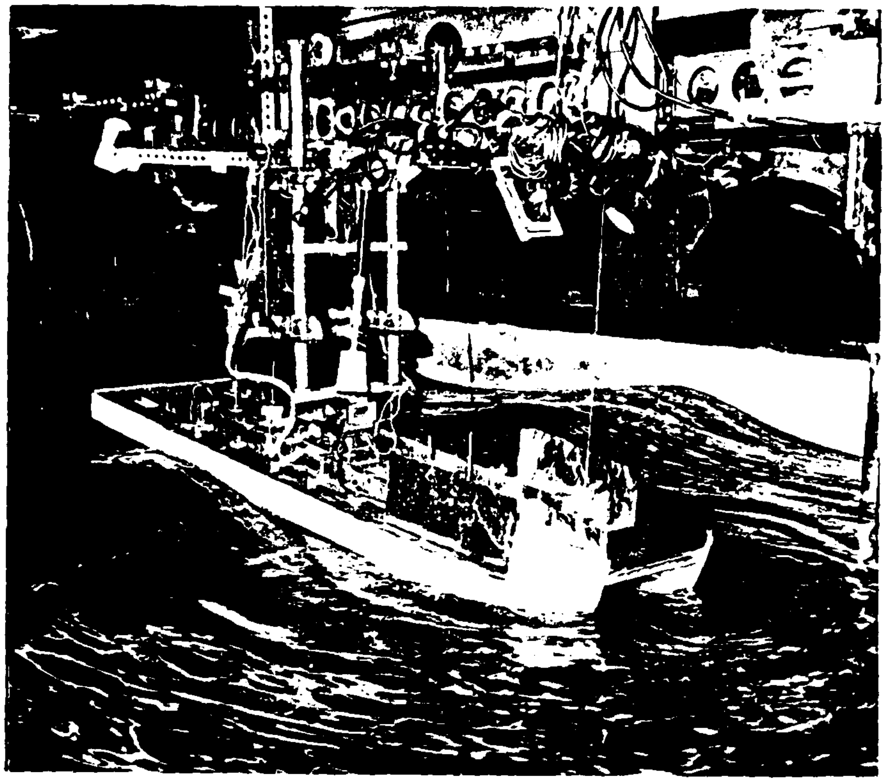


FIGURE 5-MODIFICATIONS TO ORIGINAL MODEL



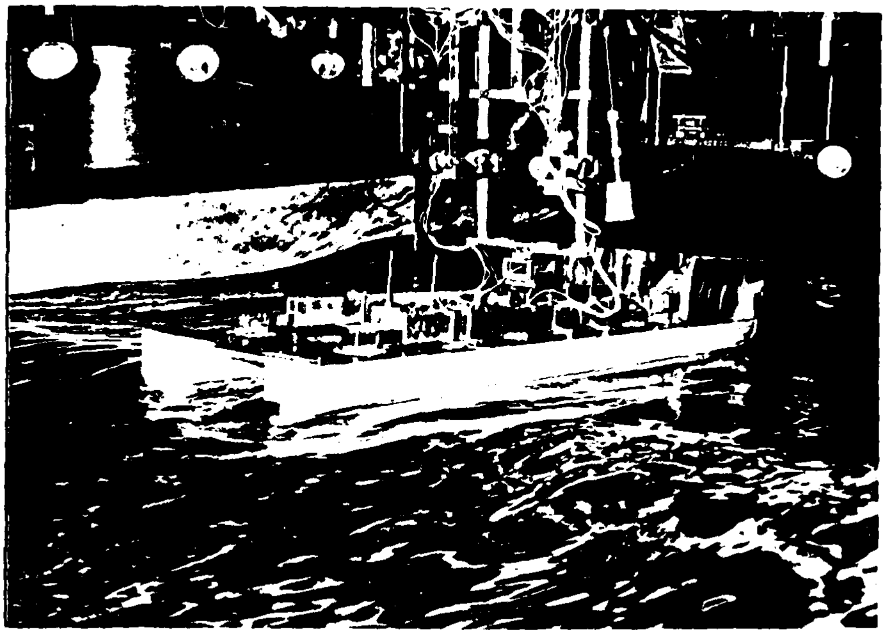


FIGURE 6-SETUP PICTURES OF BUOYANT SIDEWALL MODEL IN TANK 3

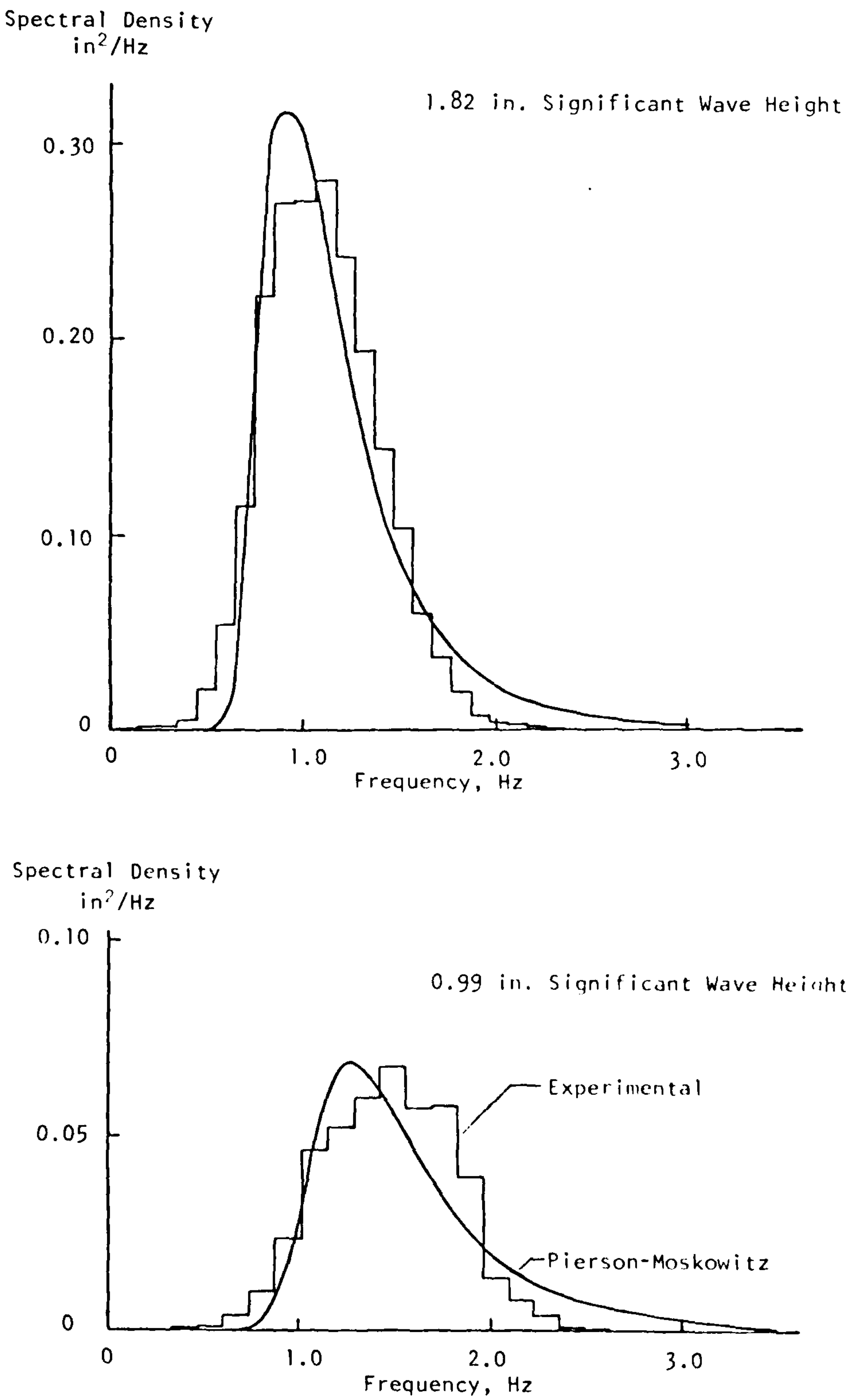


FIGURE 7 MODEL WAVE SPECTRA

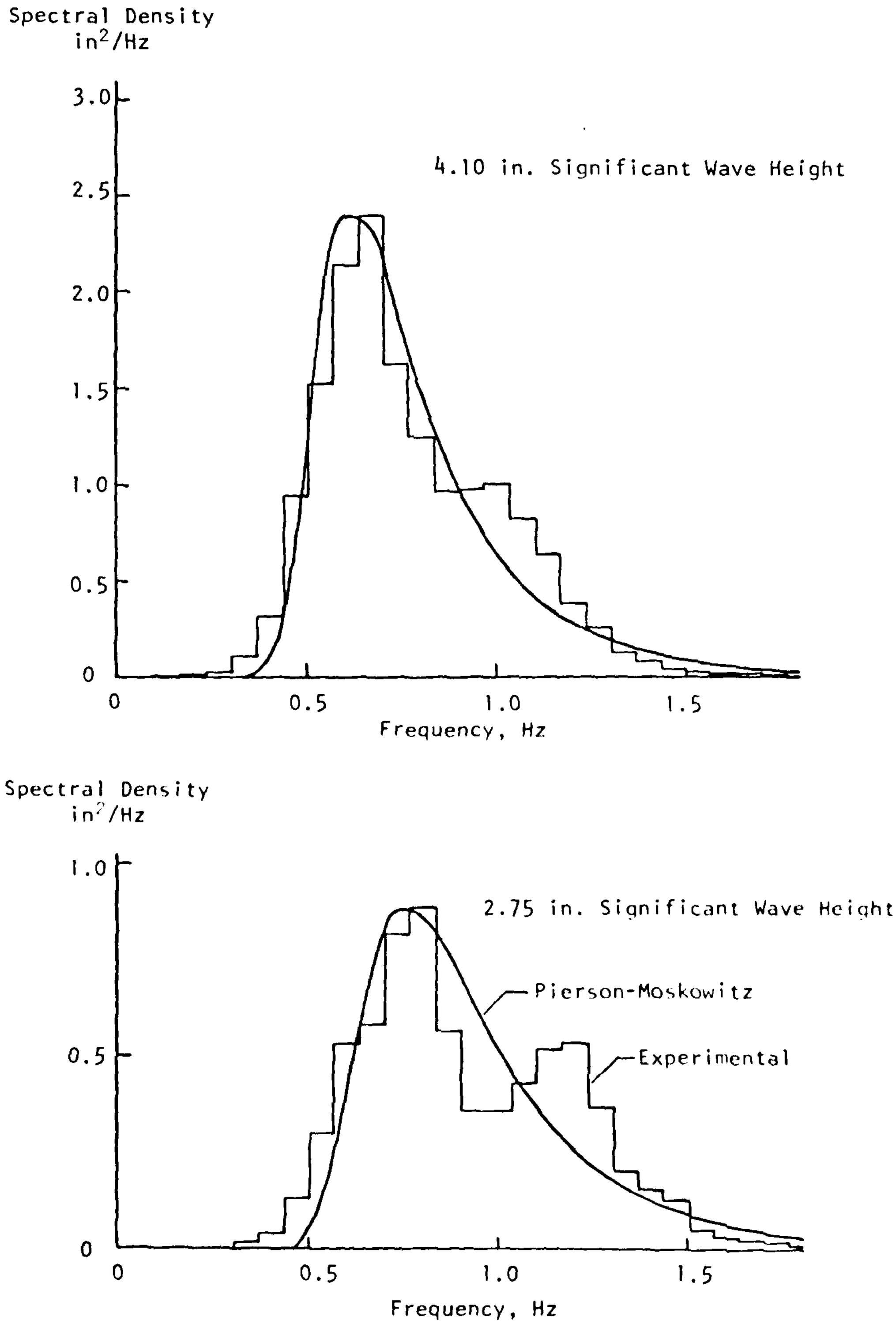
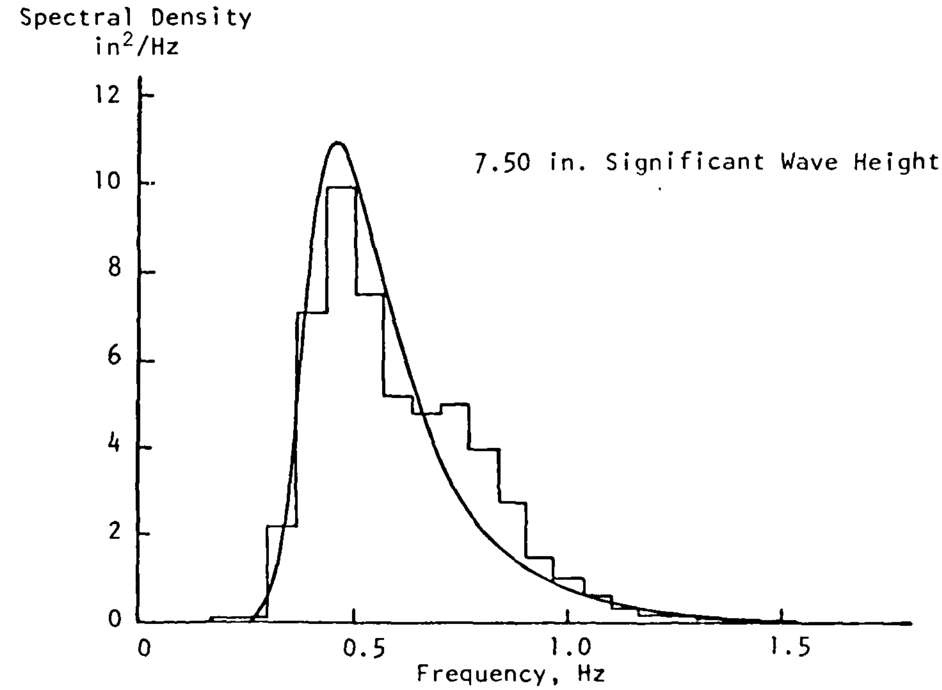


FIGURE 8 MODEL WAVE SPECTRA



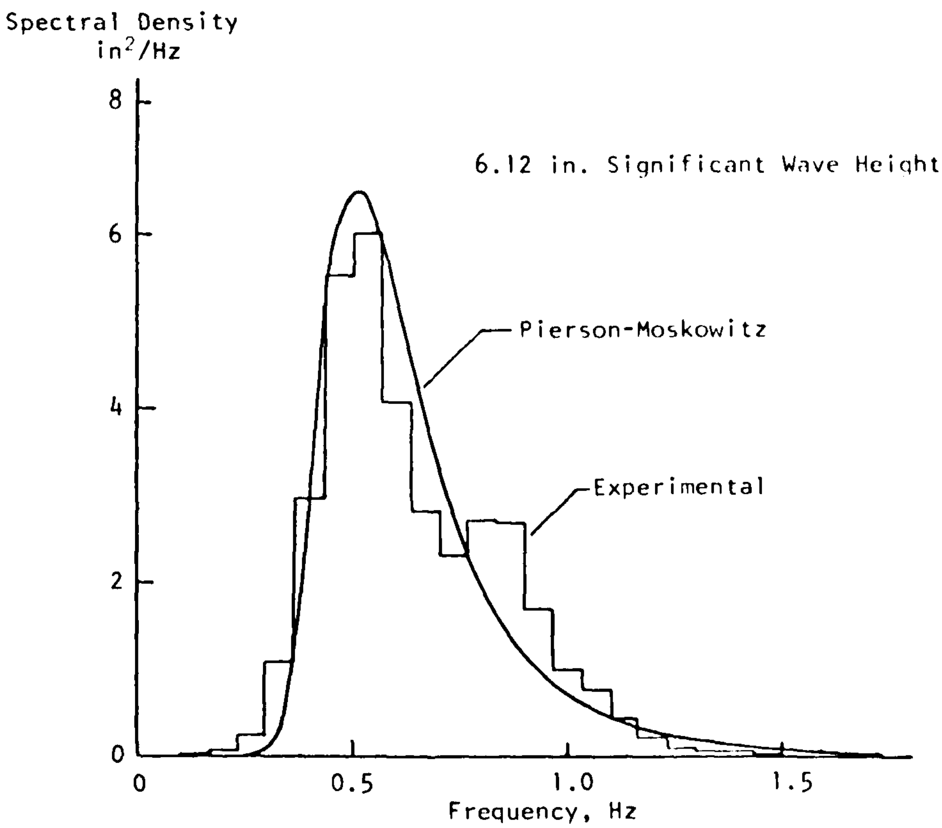


FIGURE 9 MODEL WAVE SPECTRA

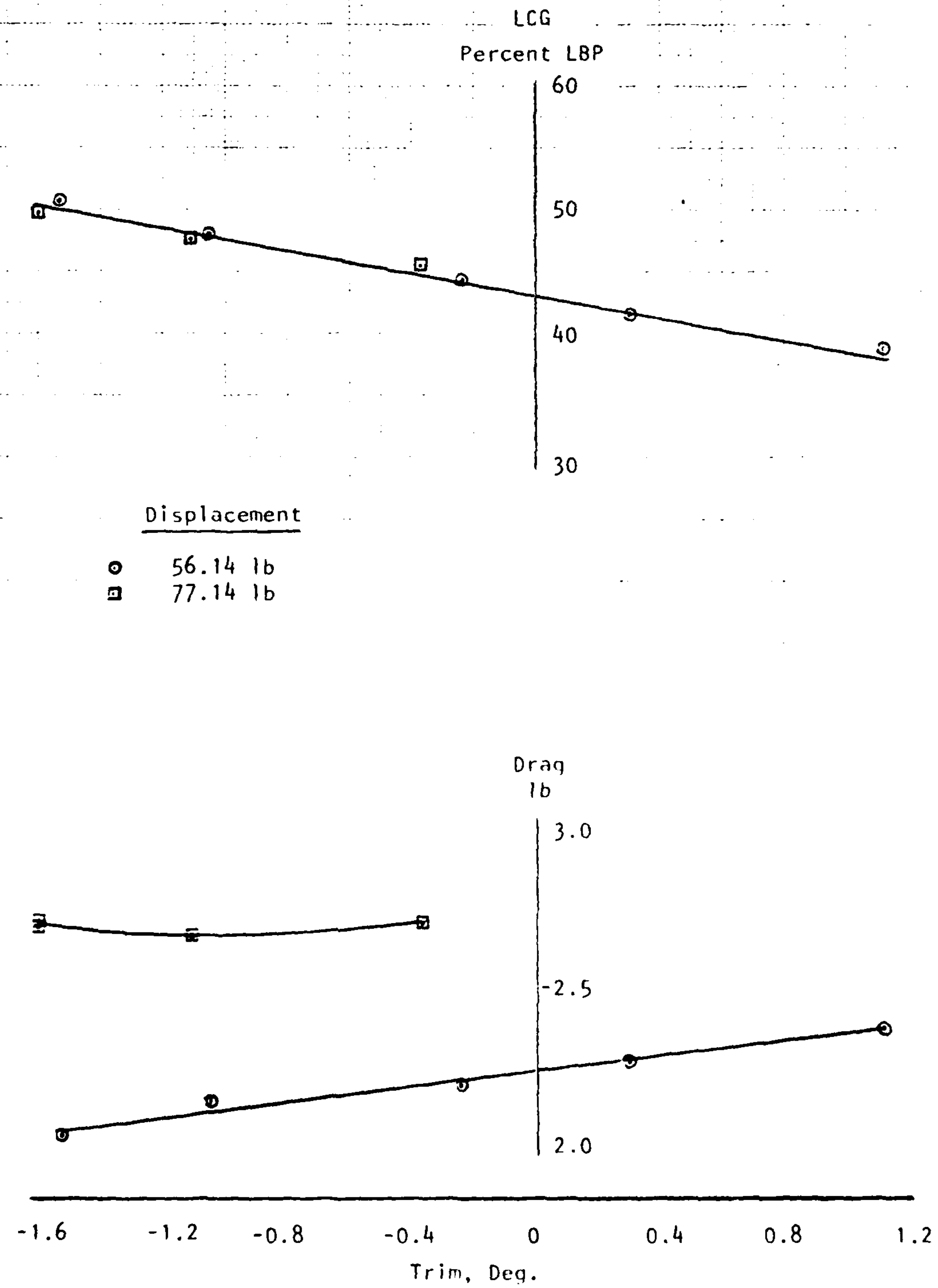


FIGURE 10 EFFECT OF SHIFTING LCG AT 4.63 FPS
Configuration 1

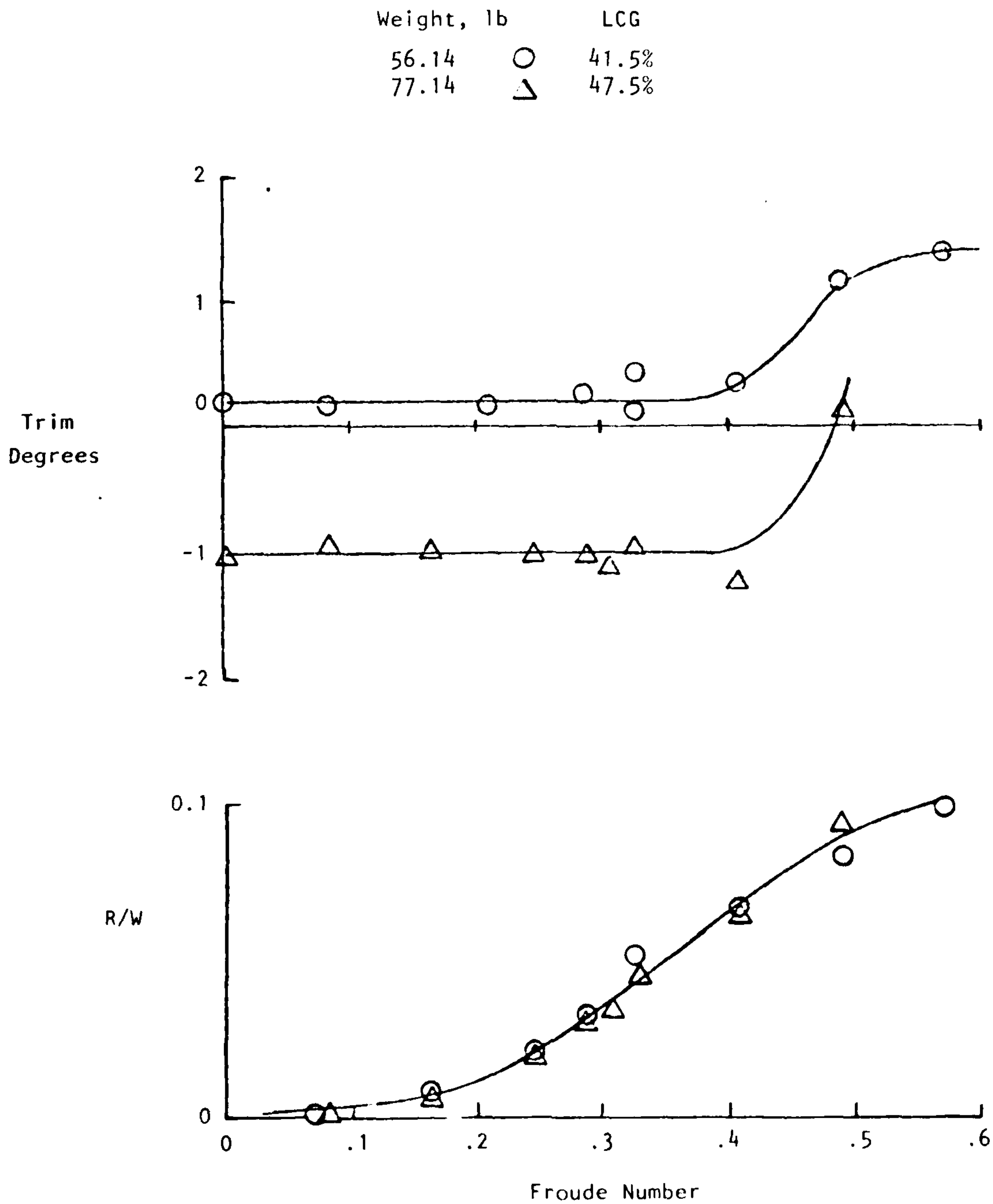


FIGURE 11 CONFIGURATION 1, DRAG AND TRIM IN CALM WATER

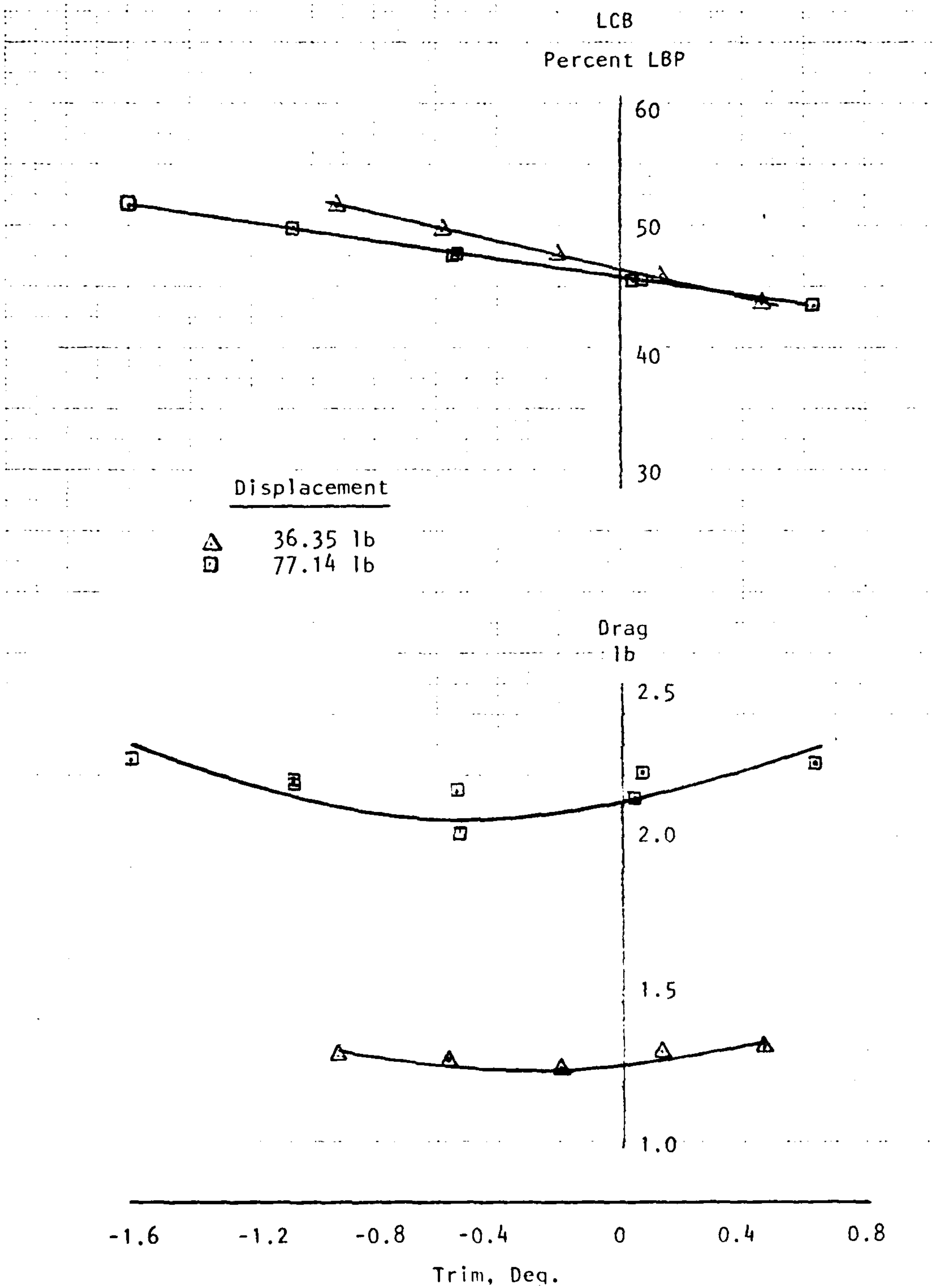


FIGURE 12 EFFECT OF SHIFTING LCG AT 4.32 FPS
Configuration 2

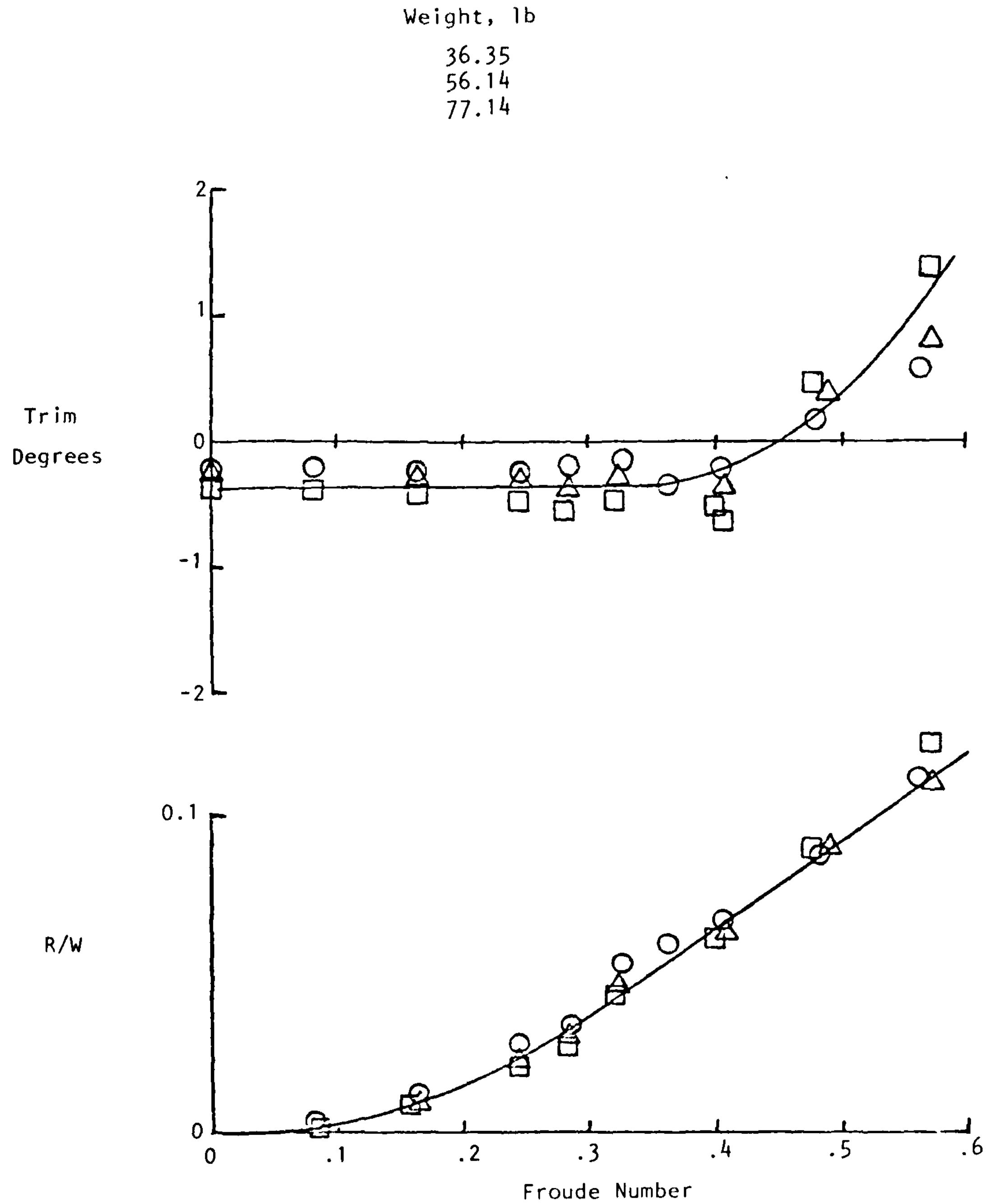


FIGURE 13 CONFIGURATION 2, DRAG AND TRIM IN CALM WATER, LCG 47.5%

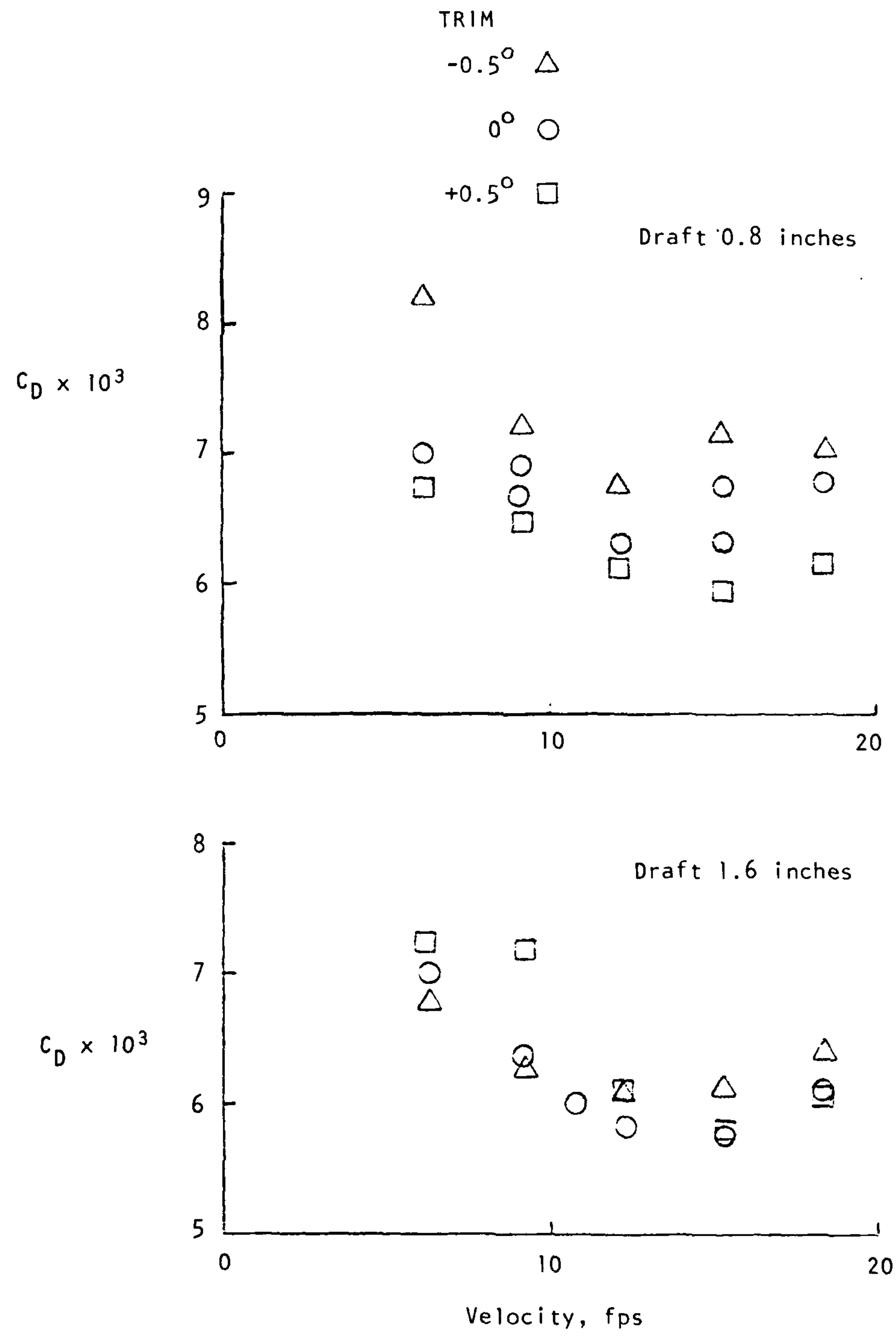


FIGURE 14 DRAG FIXED TRIM AND HEAVE (Configuration 2) FOR CUSHION-BORNE OPERATION

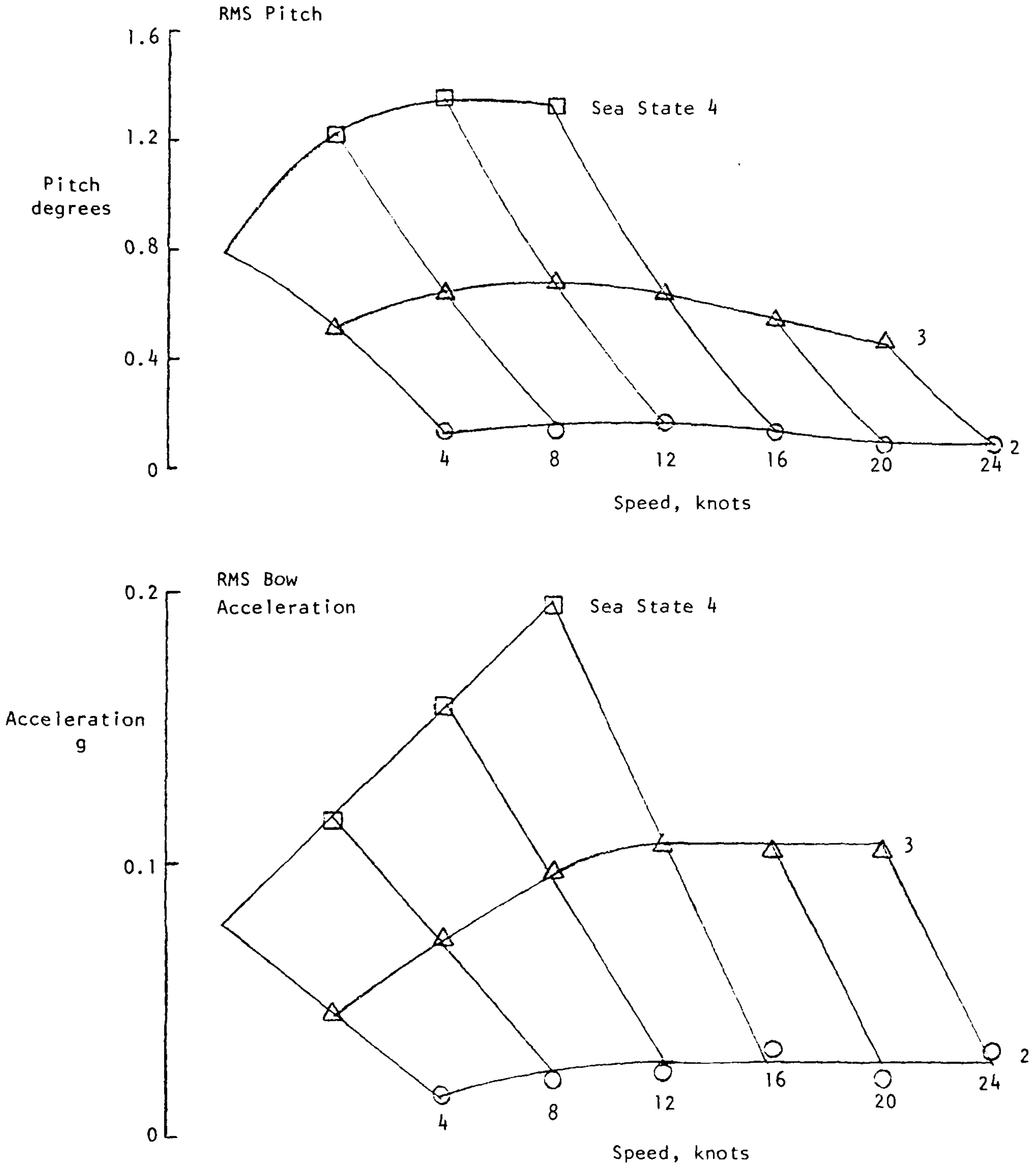


FIGURE 15 SEAKEEPING OF 700 TON SES IN HEADSEAS
(1/30-scale configuration 1)

Load, lb	Froude Number 0.33	0.41
56.14	○	●
77.14	△	▲

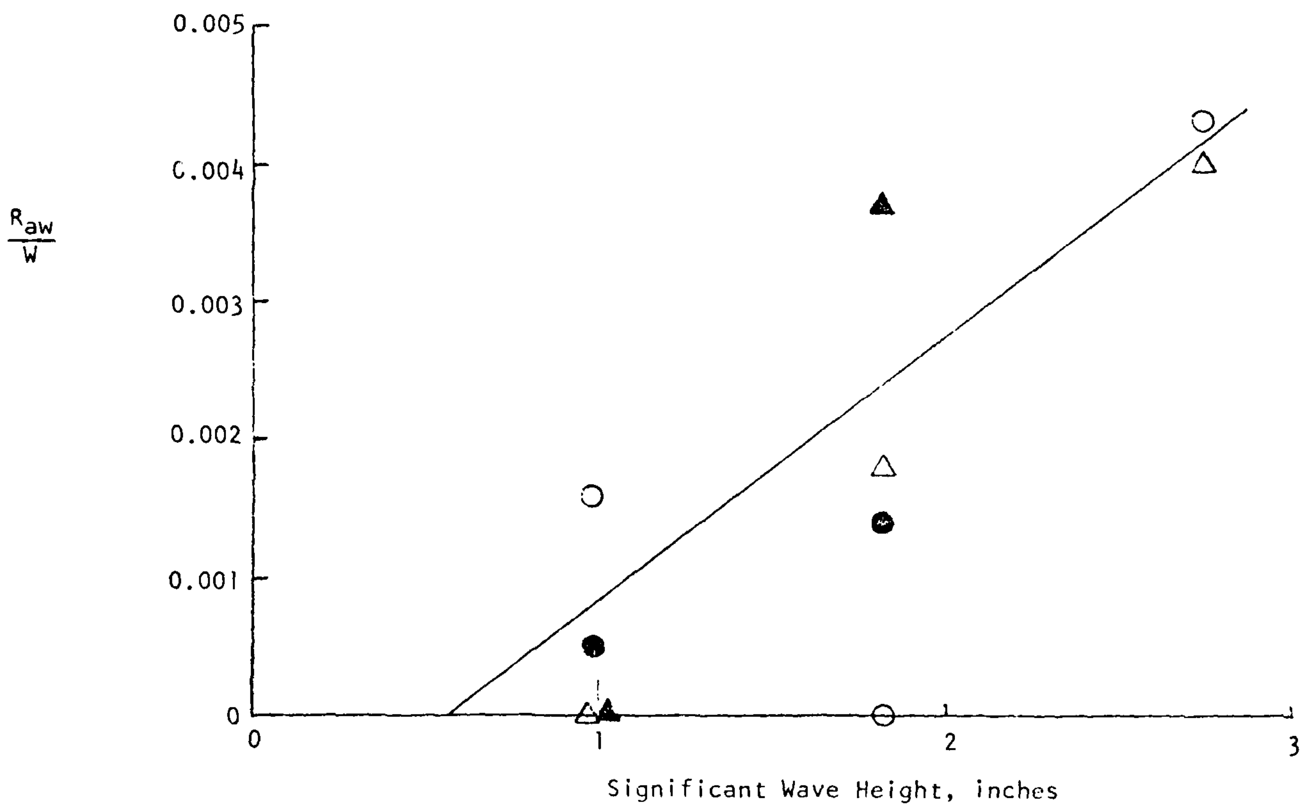


FIGURE 16 ADDED RESISTANCE IN WAVES (Configuration 1)

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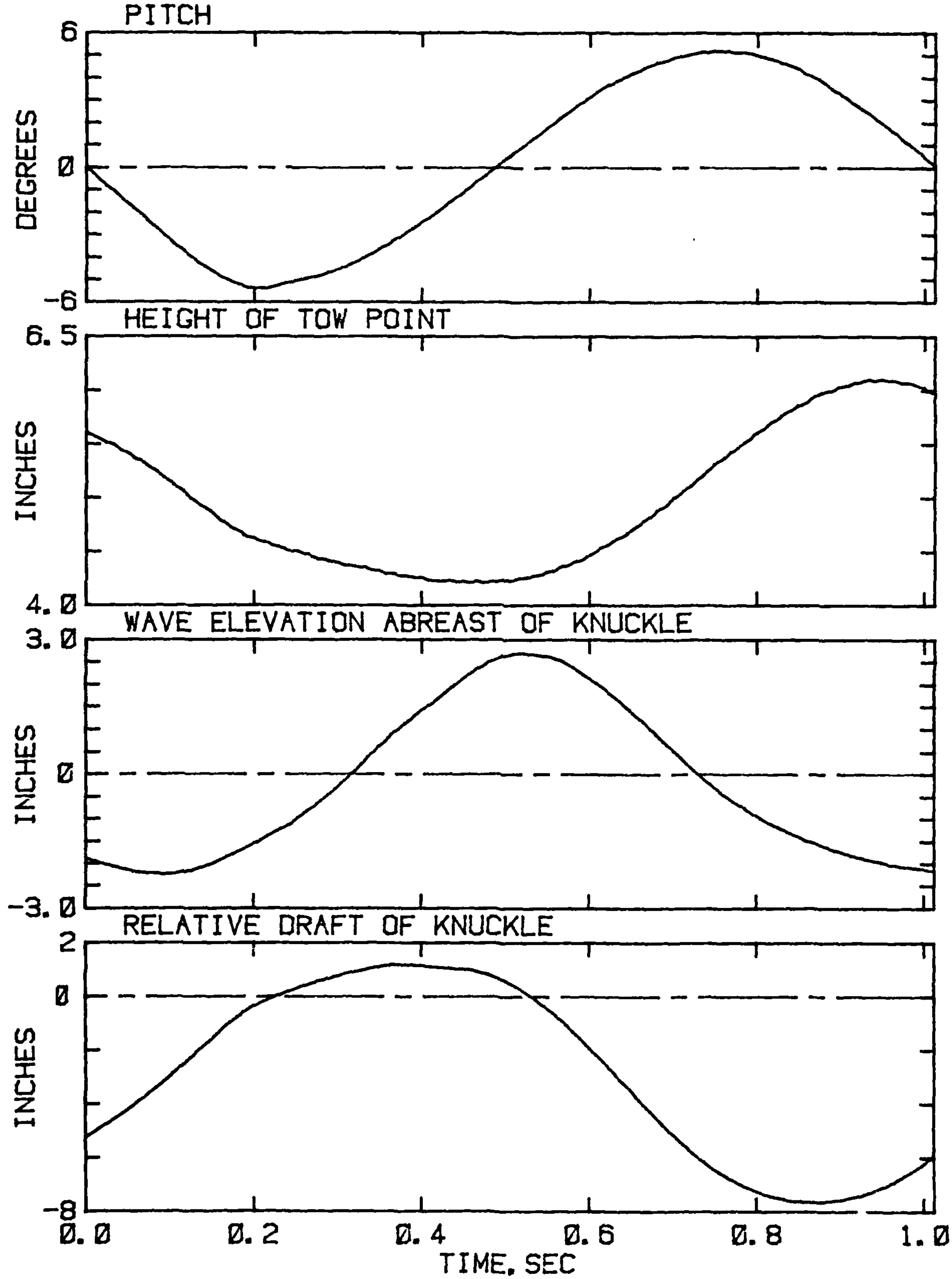

FIGURE 17a MOTION TIME HISTORY FOR RUN 260

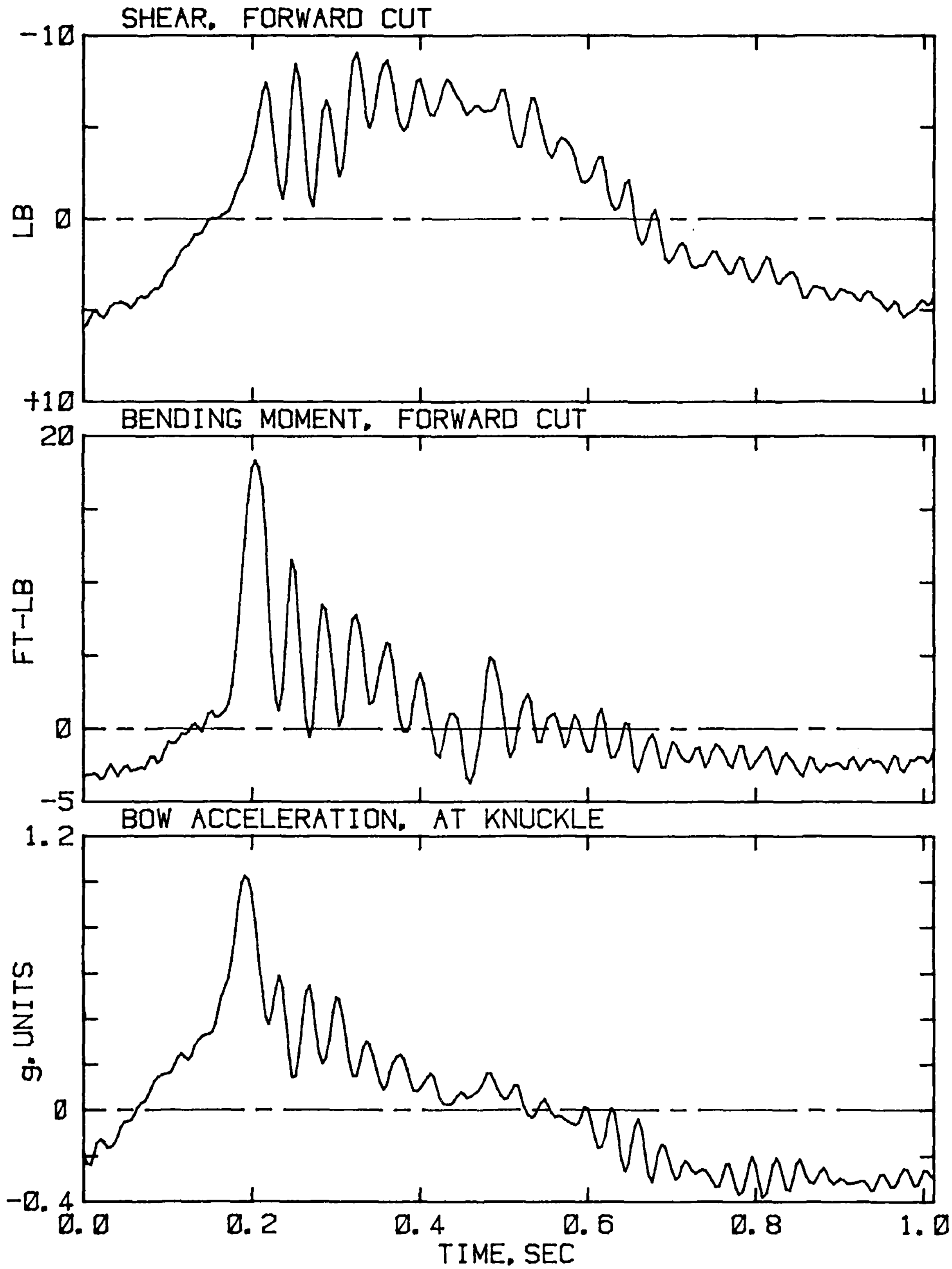

FIGURE 17b FORCE AND MOMENT TIME HISTORY FOR RUN 260

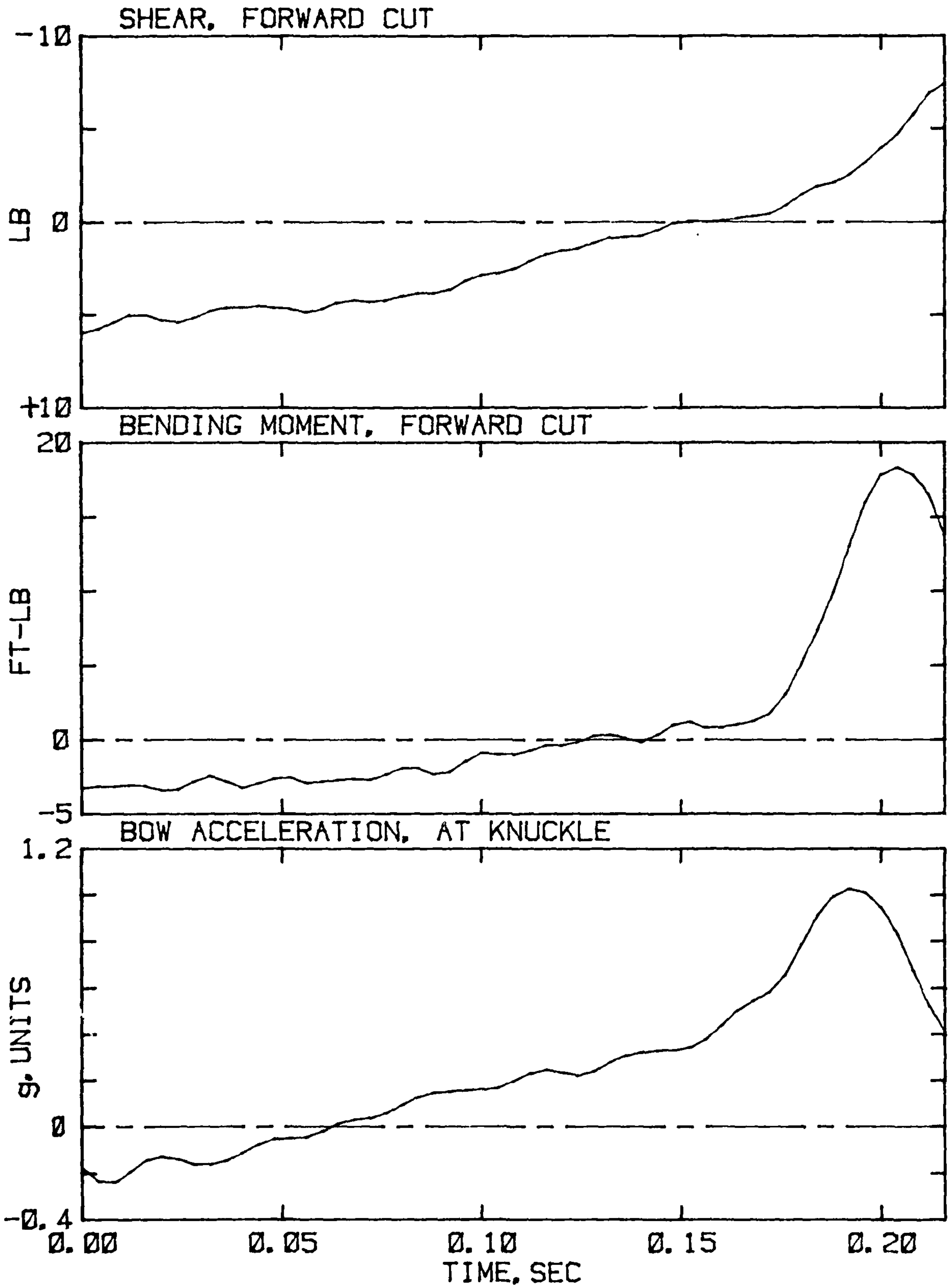

FIGURE 17c DETAIL OF RISE TIME, RUN 260

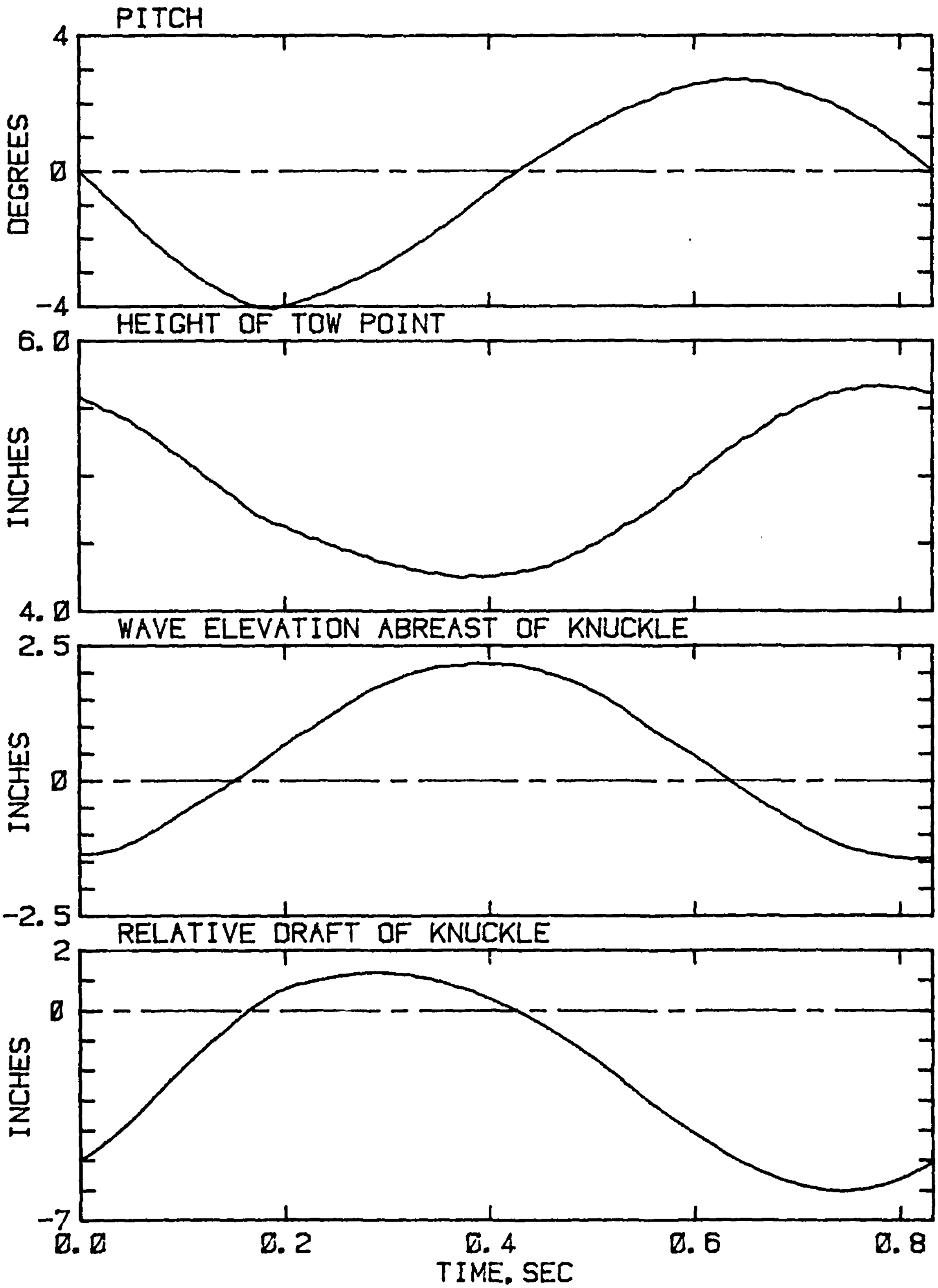

FIGURE 18a MOTION TIME HISTORY FOR RUN 261

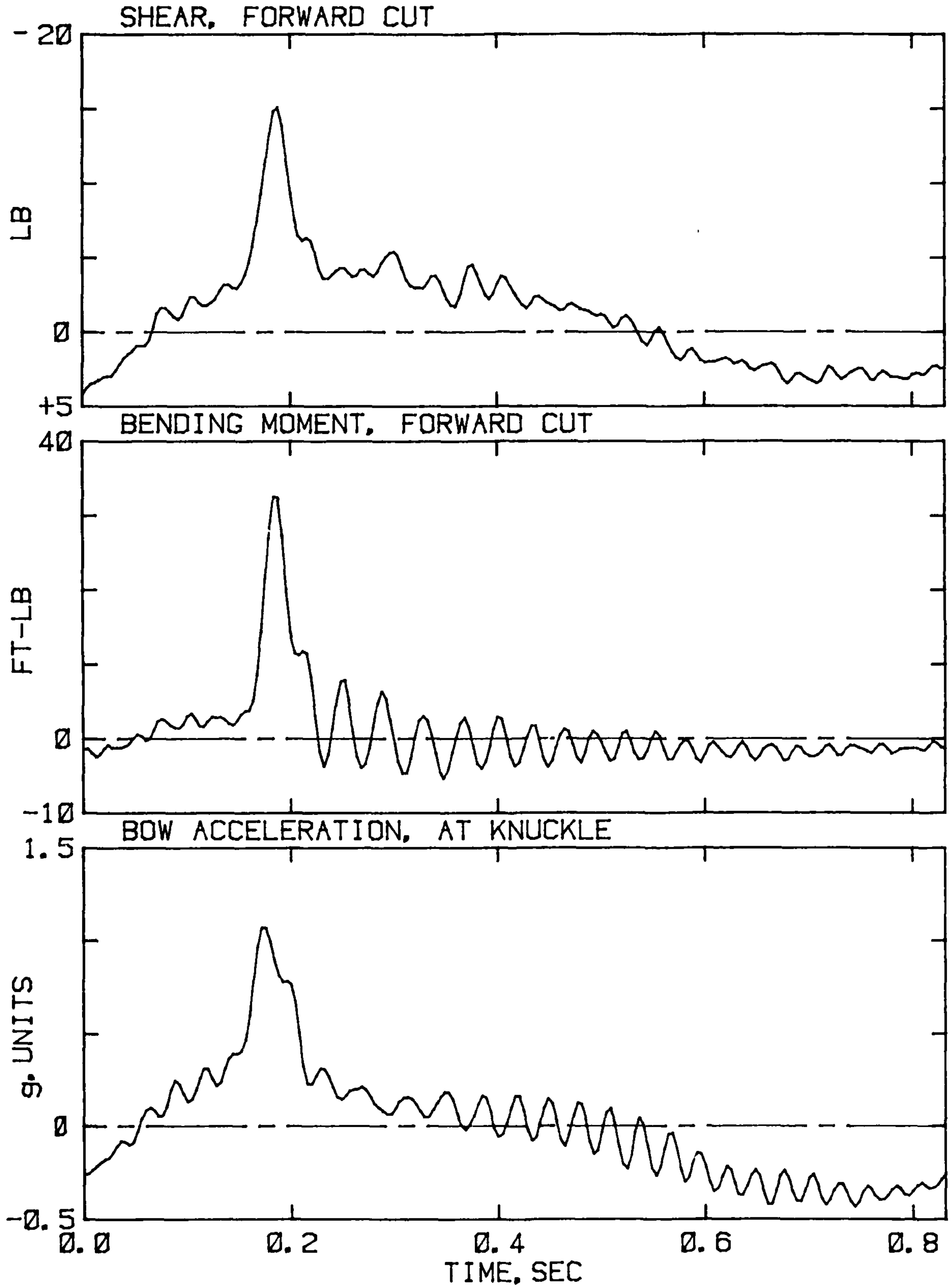

FIGURE 18b FORCE AND MOMENT TIME HISTORY FOR RUN 261

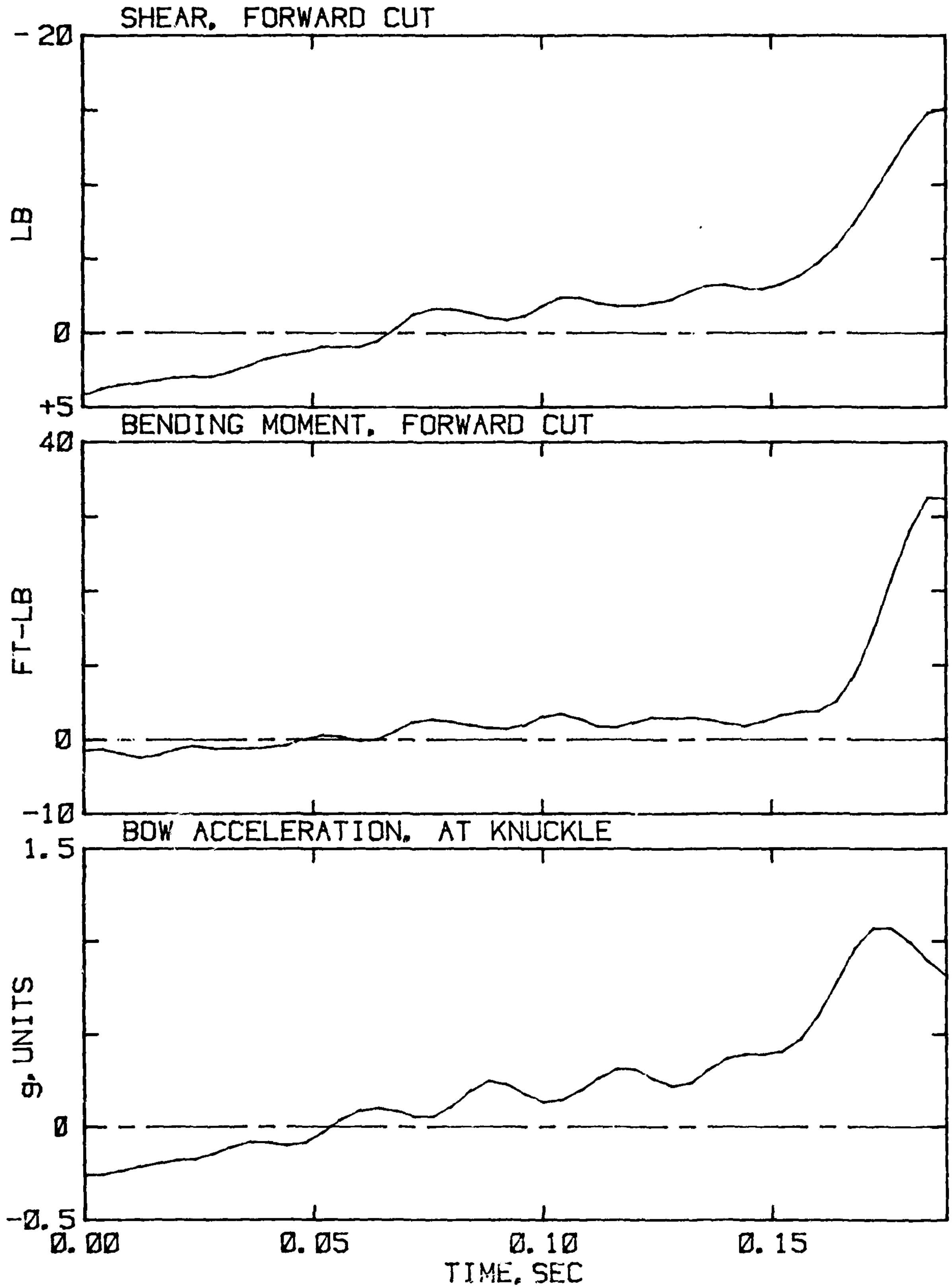

FIGURE 18c DETAIL OF RISE TIME, RUN 261

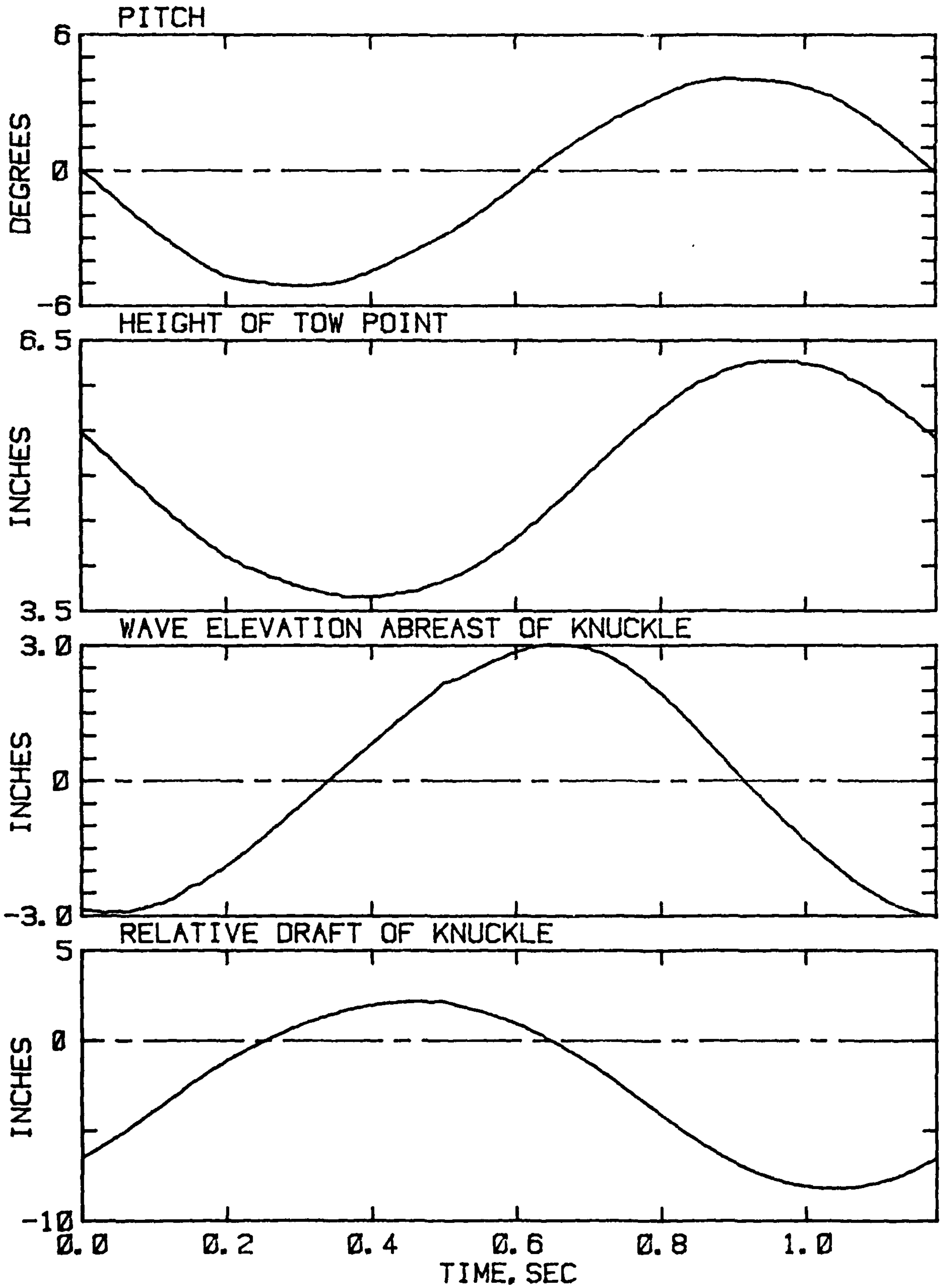

FIGURE 19a MOTION TIME HISTORY FOR RUN 262

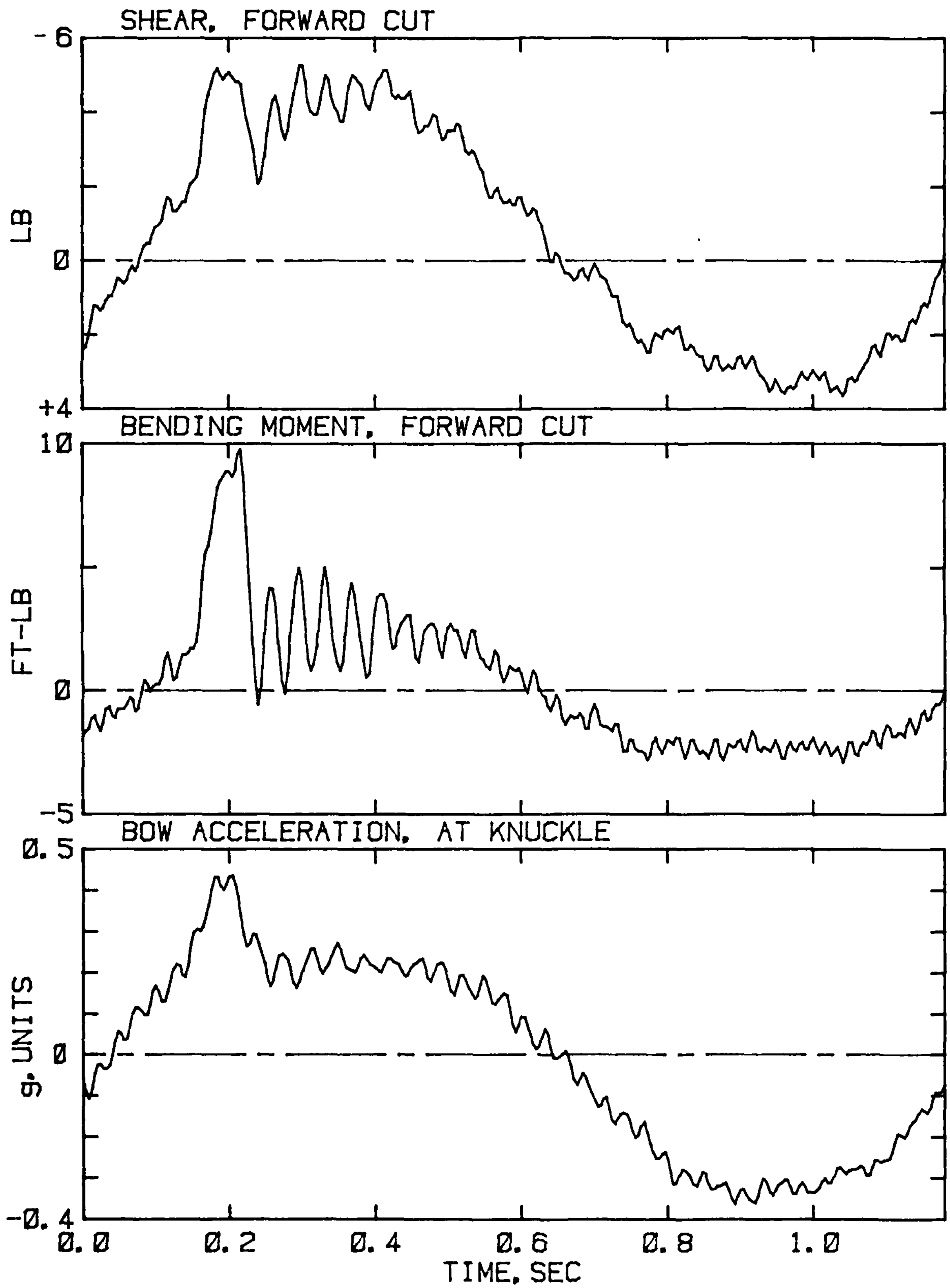

FIGURE 19b FORCE AND MOMENT TIME HISTORY FOR RUN 262

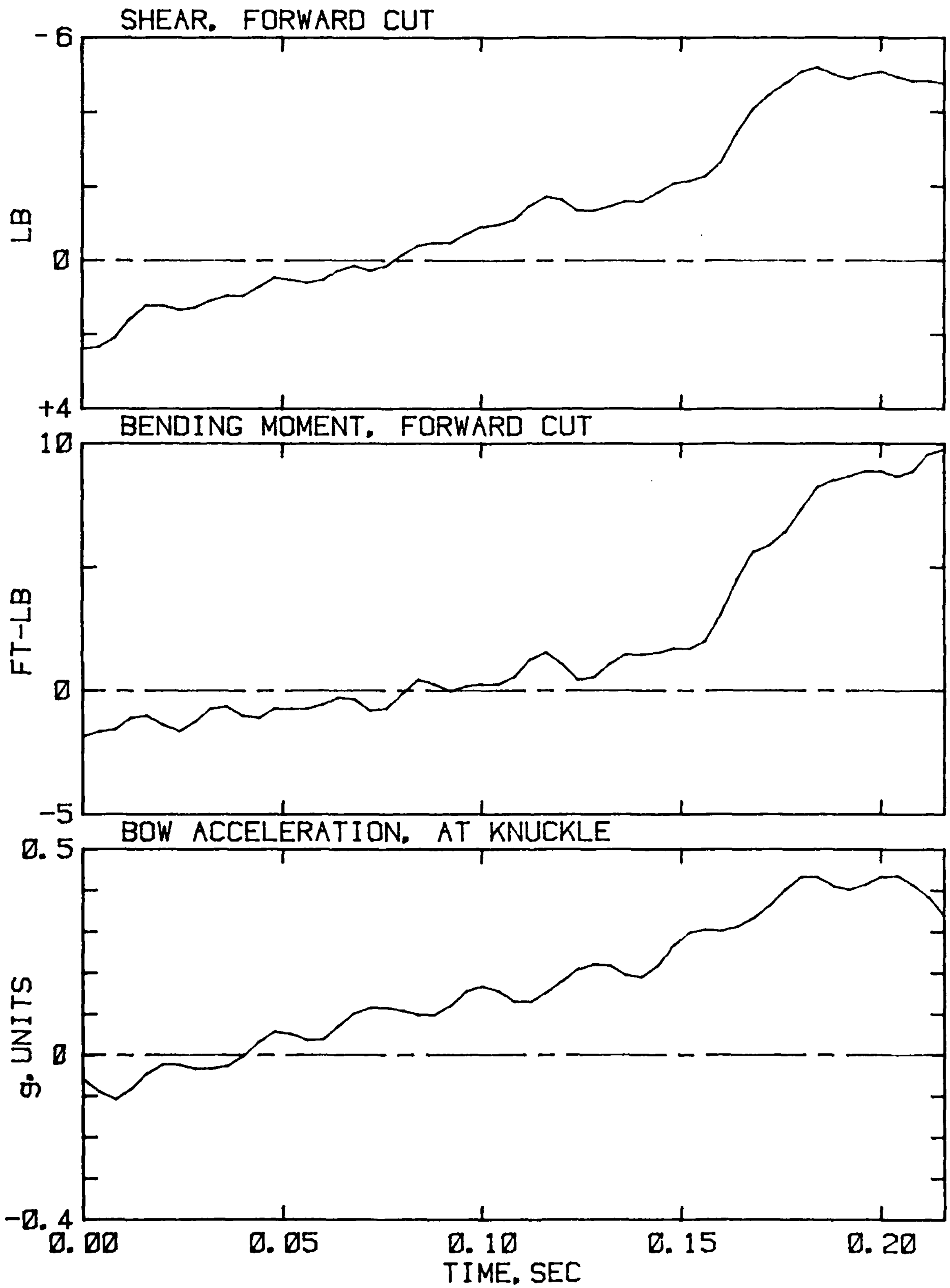

FIGURE 19c DETAIL OF RISE TIME, RUN 262

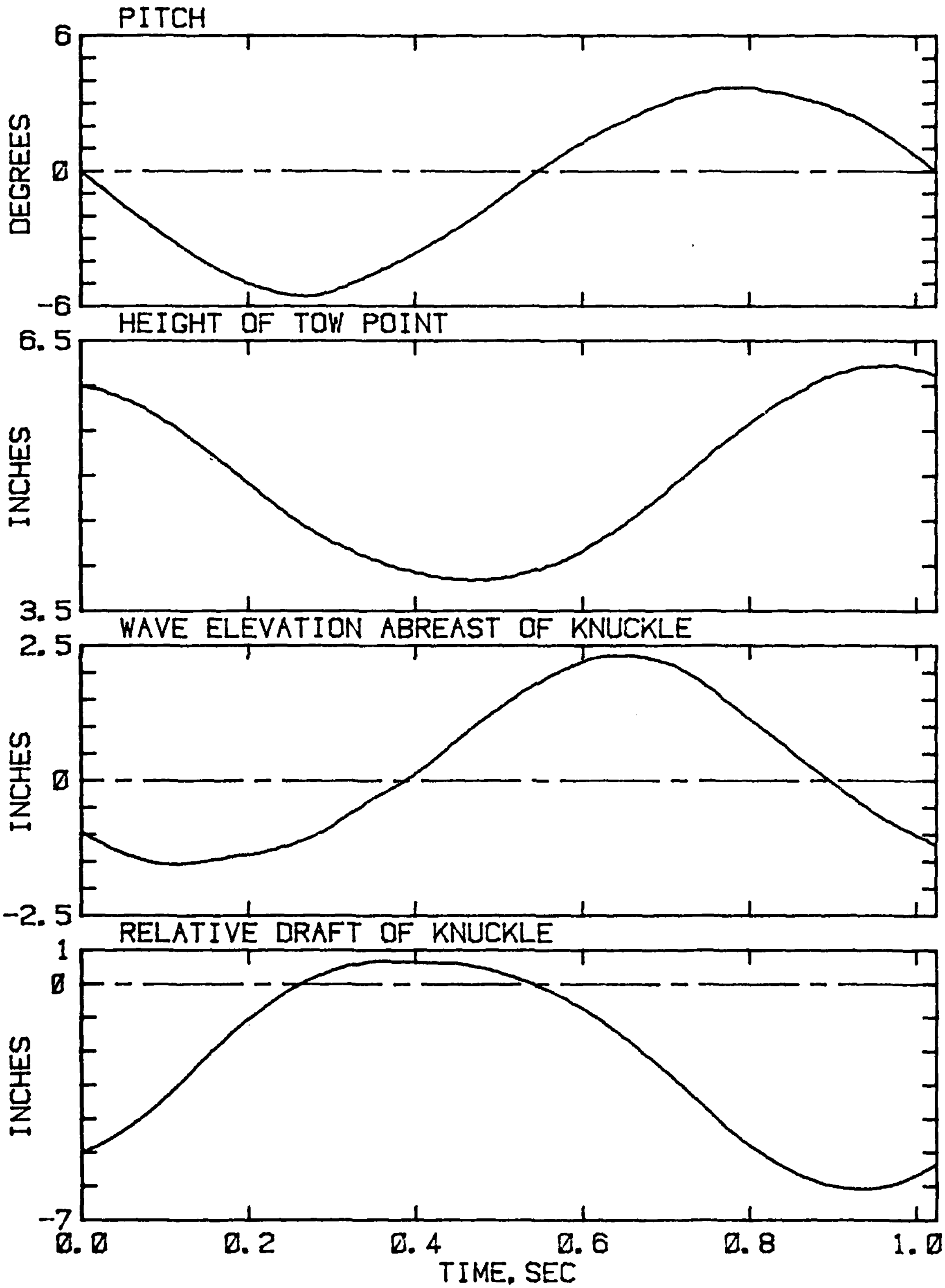

FIGURE 20a MOTION TIME HISTORY FOR RUN 263

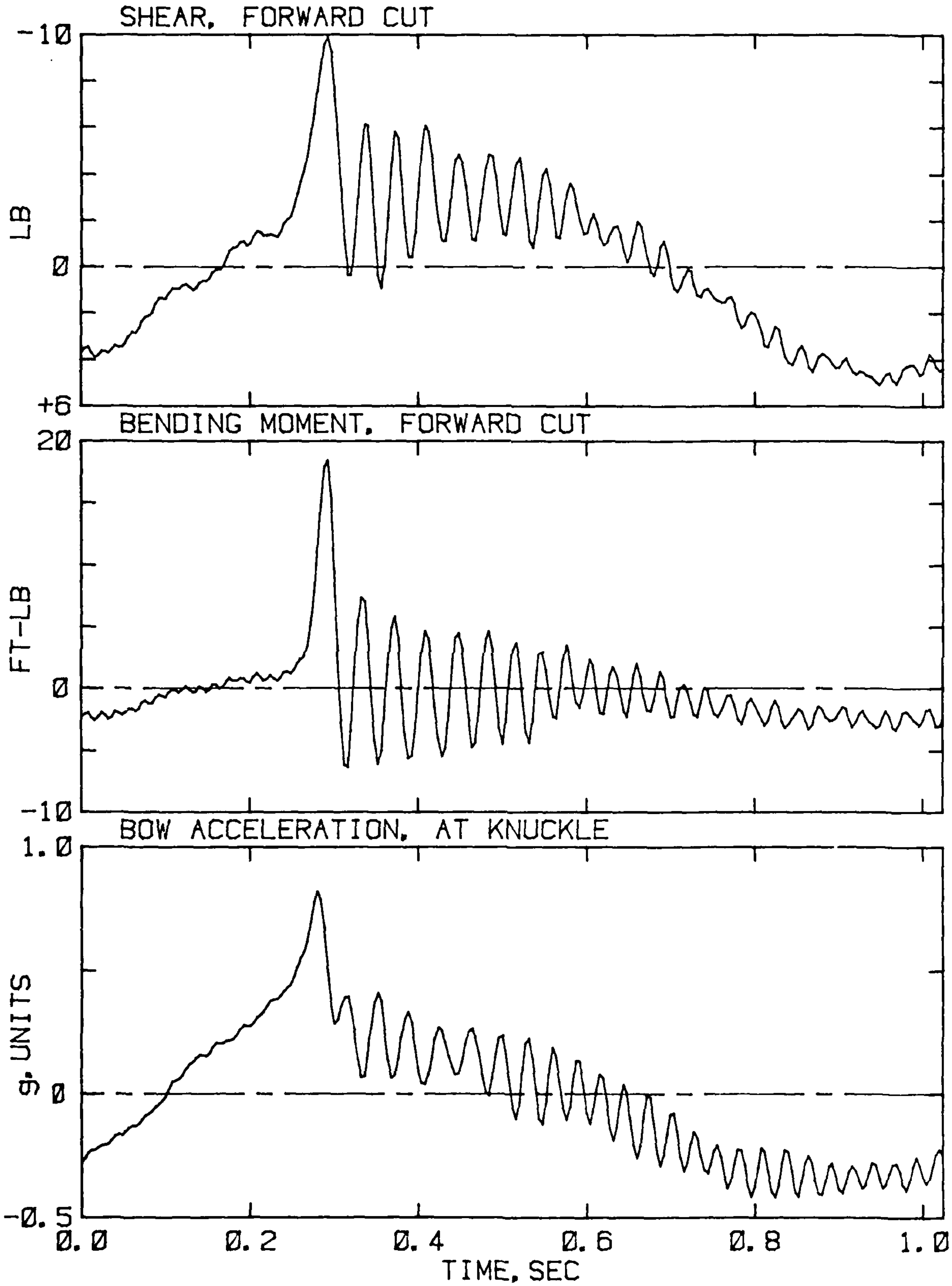

FIGURE 20b FORCE AND MOMENT TIME HISTORY FOR RUN 263

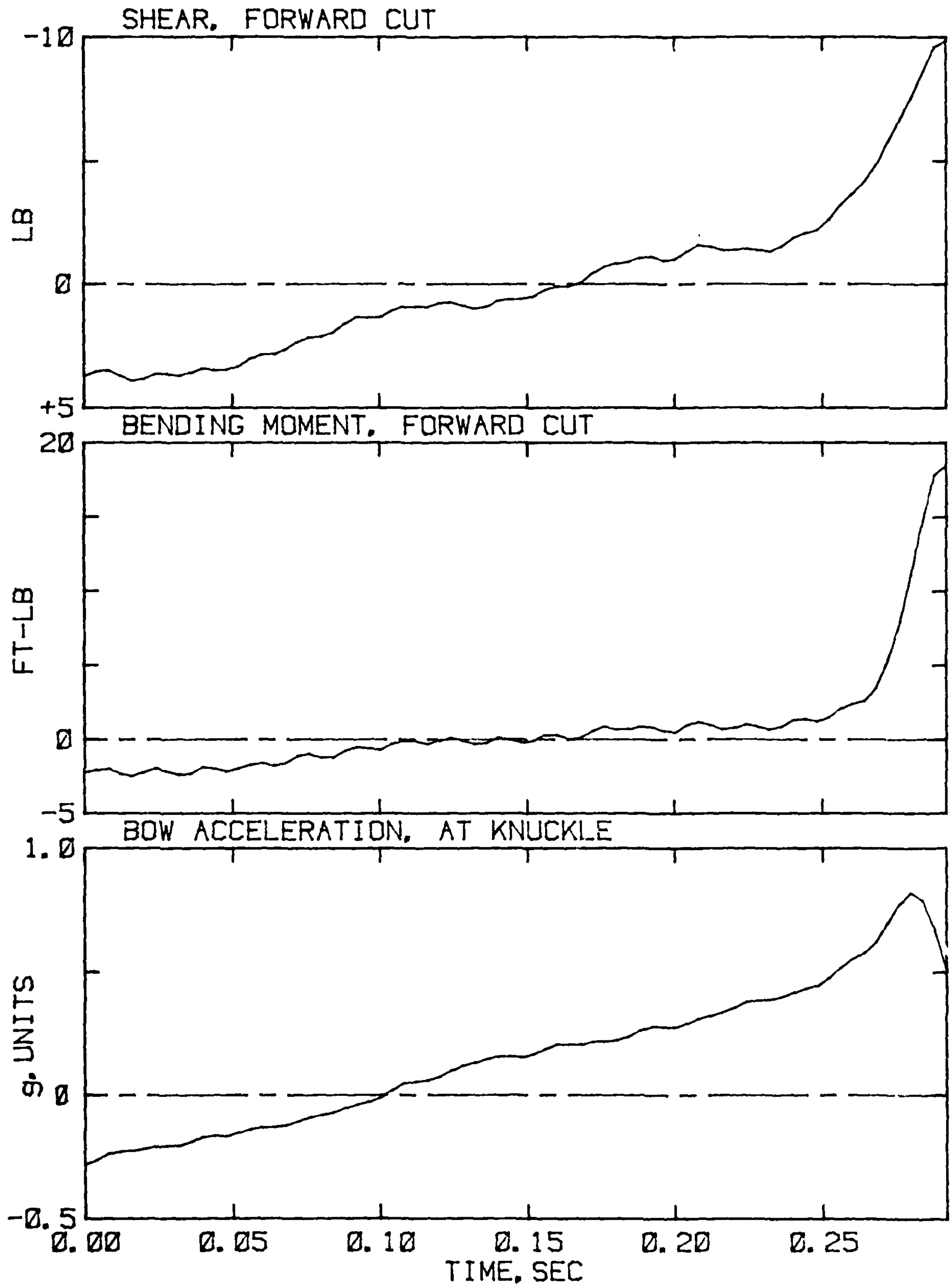

FIGURE 20c DETAIL OF RISE TIME, RUN 263

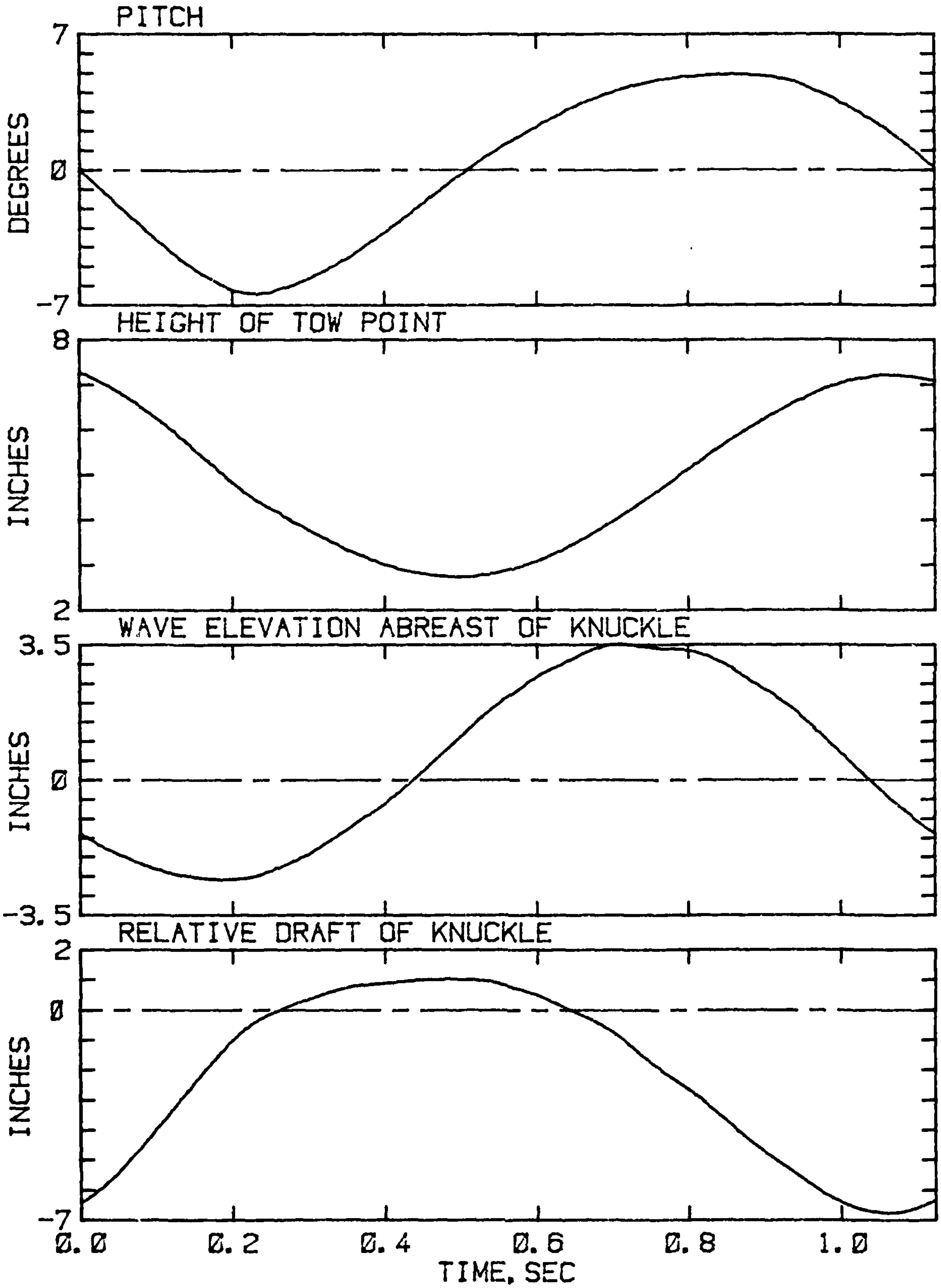

FIGURE 21a MOTION TIME HISTORY FOR RUN 264

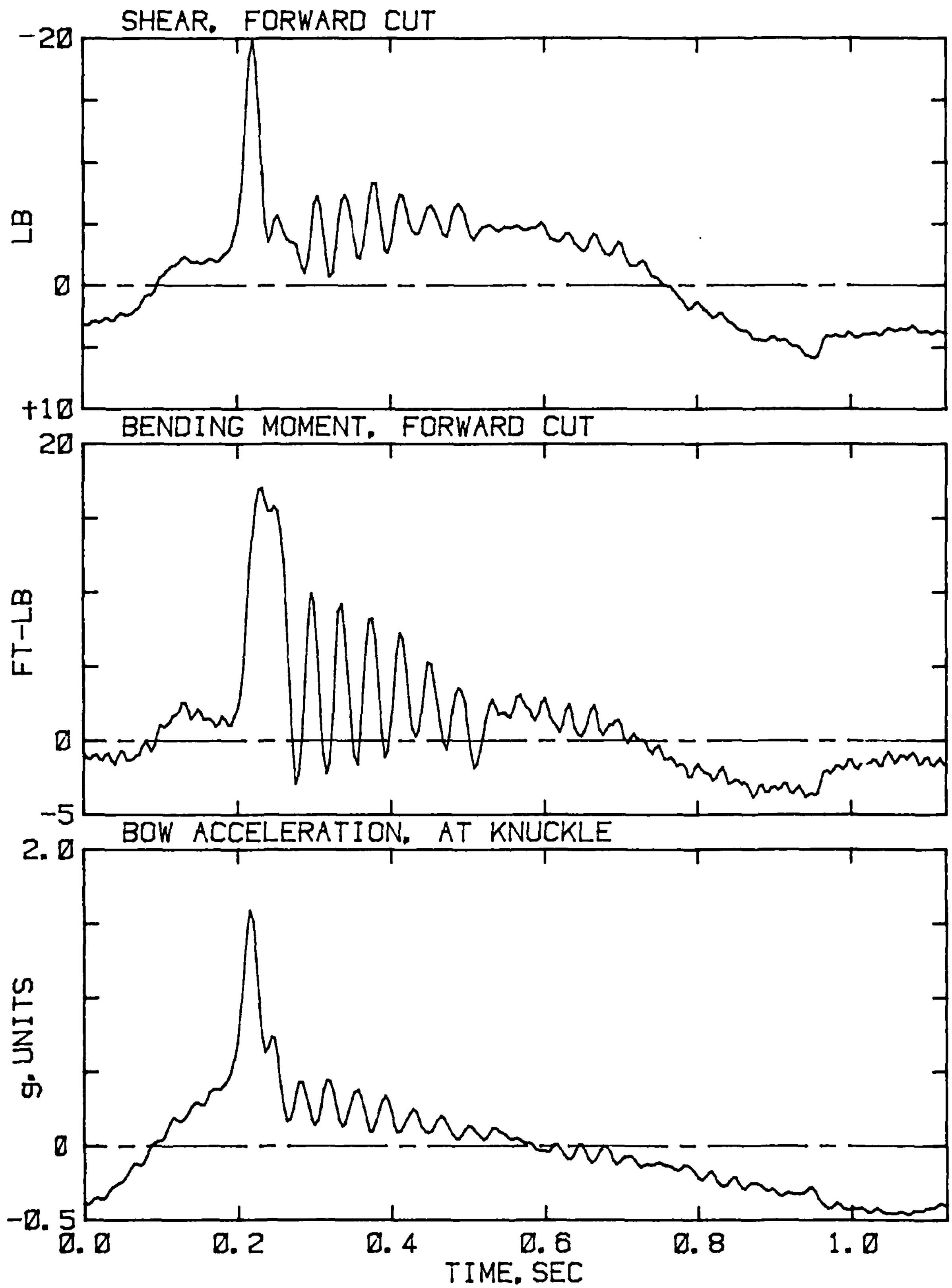

FIGURE 21b FORCE AND MOMENT TIME HISTORY FOR RUN 264

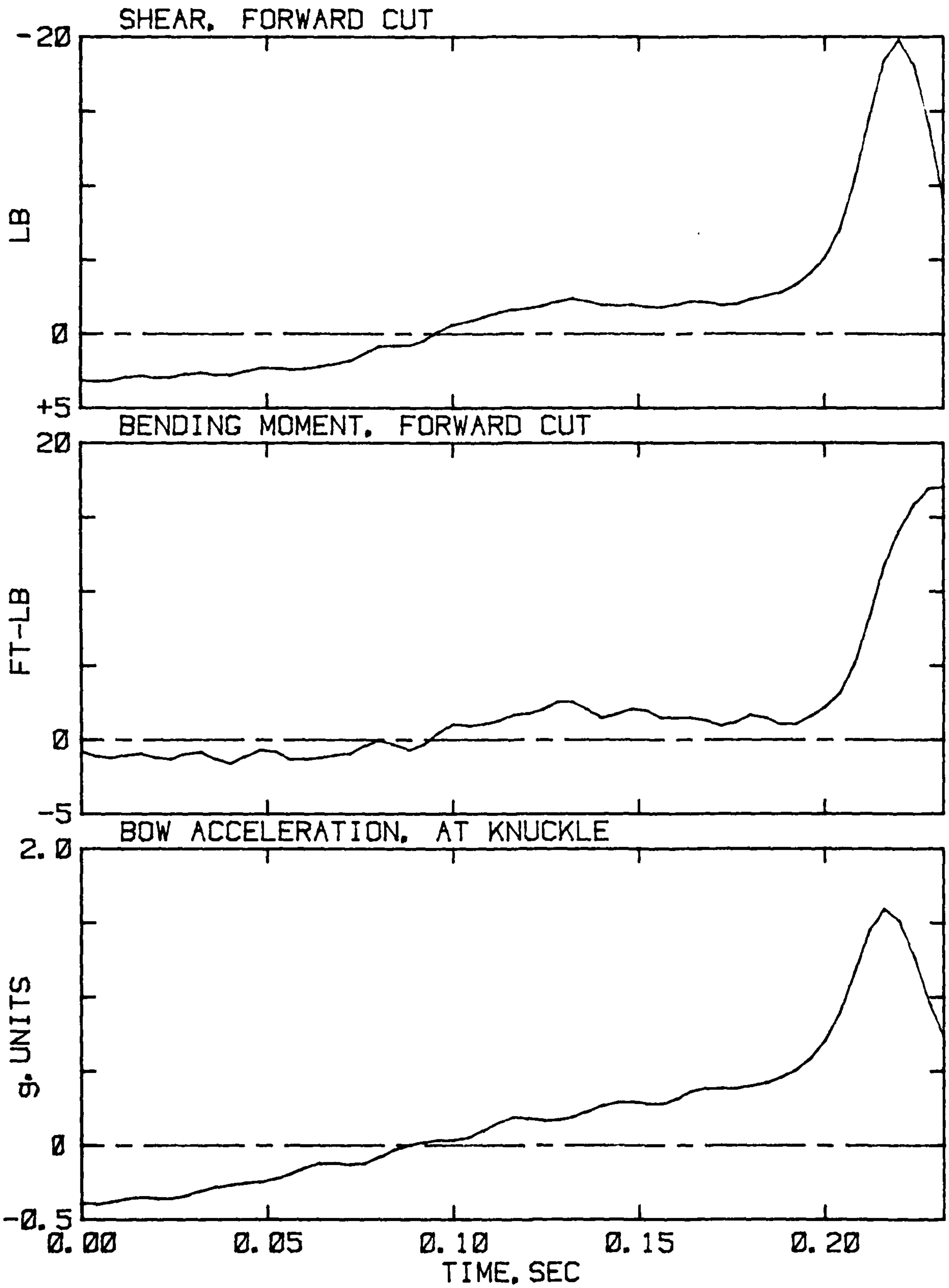

FIGURE 21c DETAIL OF RISE TIME, RUN 264

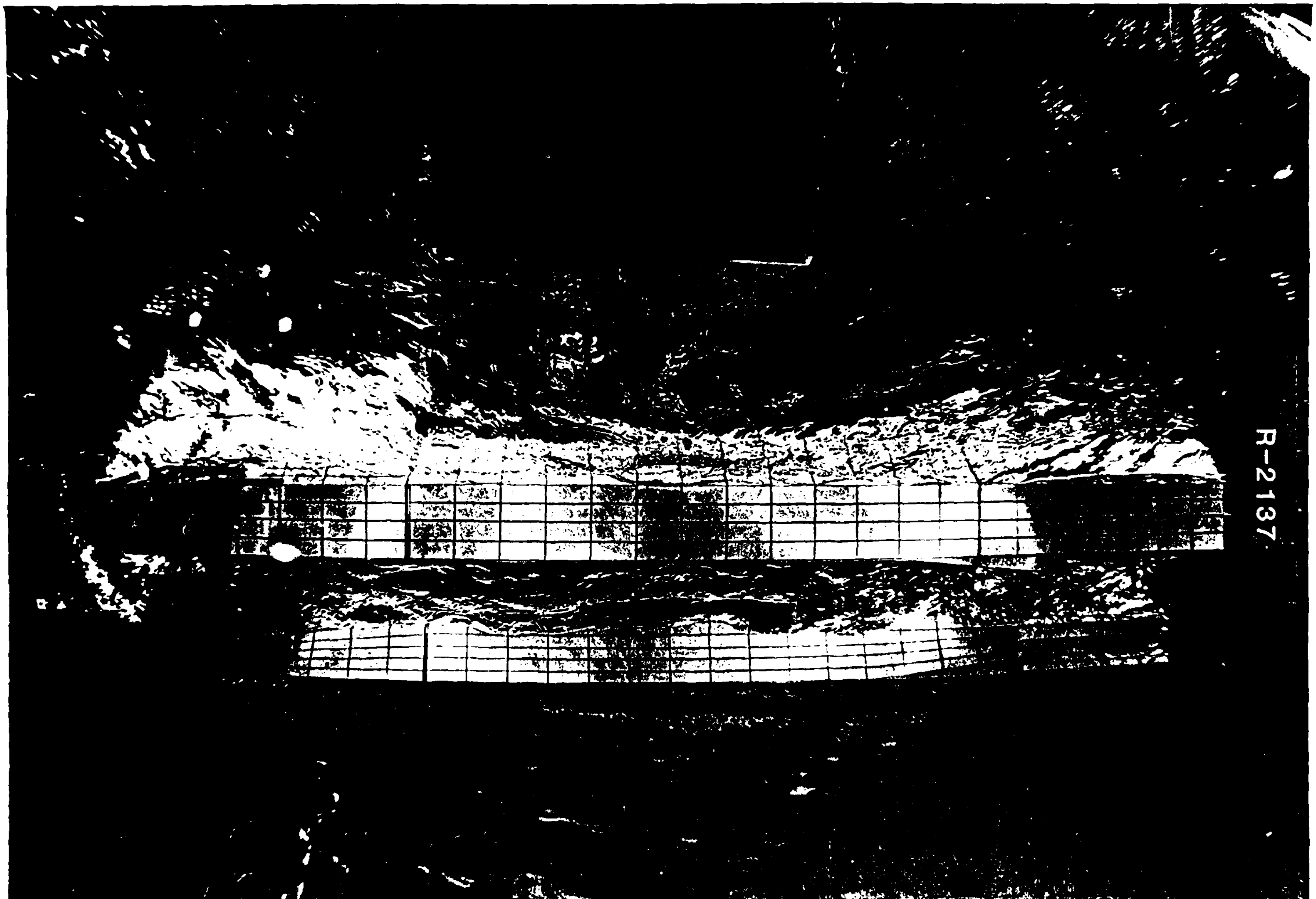

FIGURE 22 INSTANTANEOUS SIDEWALL WETTING OF RUN 262

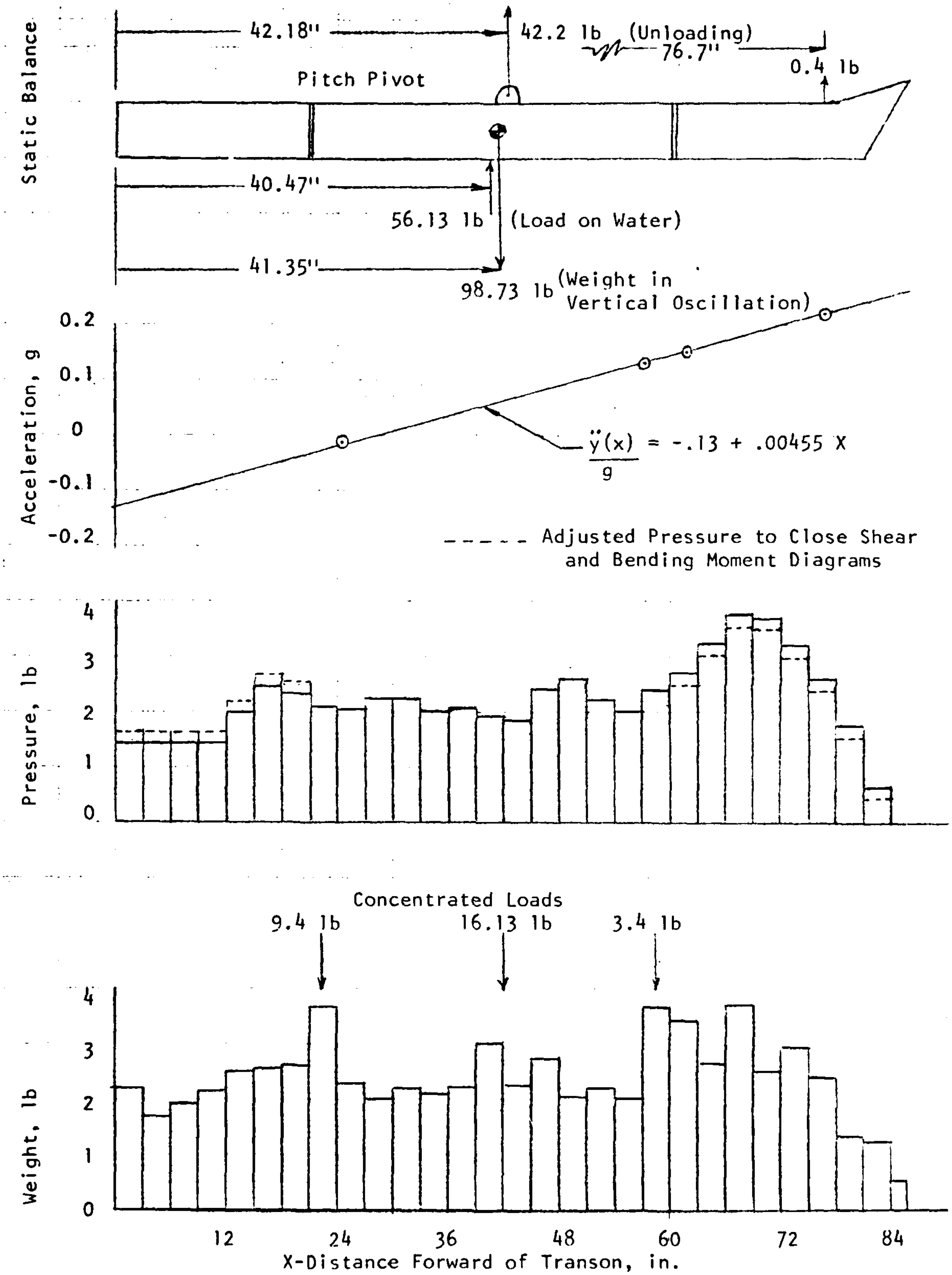

FIGURE 23 EXPERIMENTAL DISTRIBUTIONS FOR RUN 262

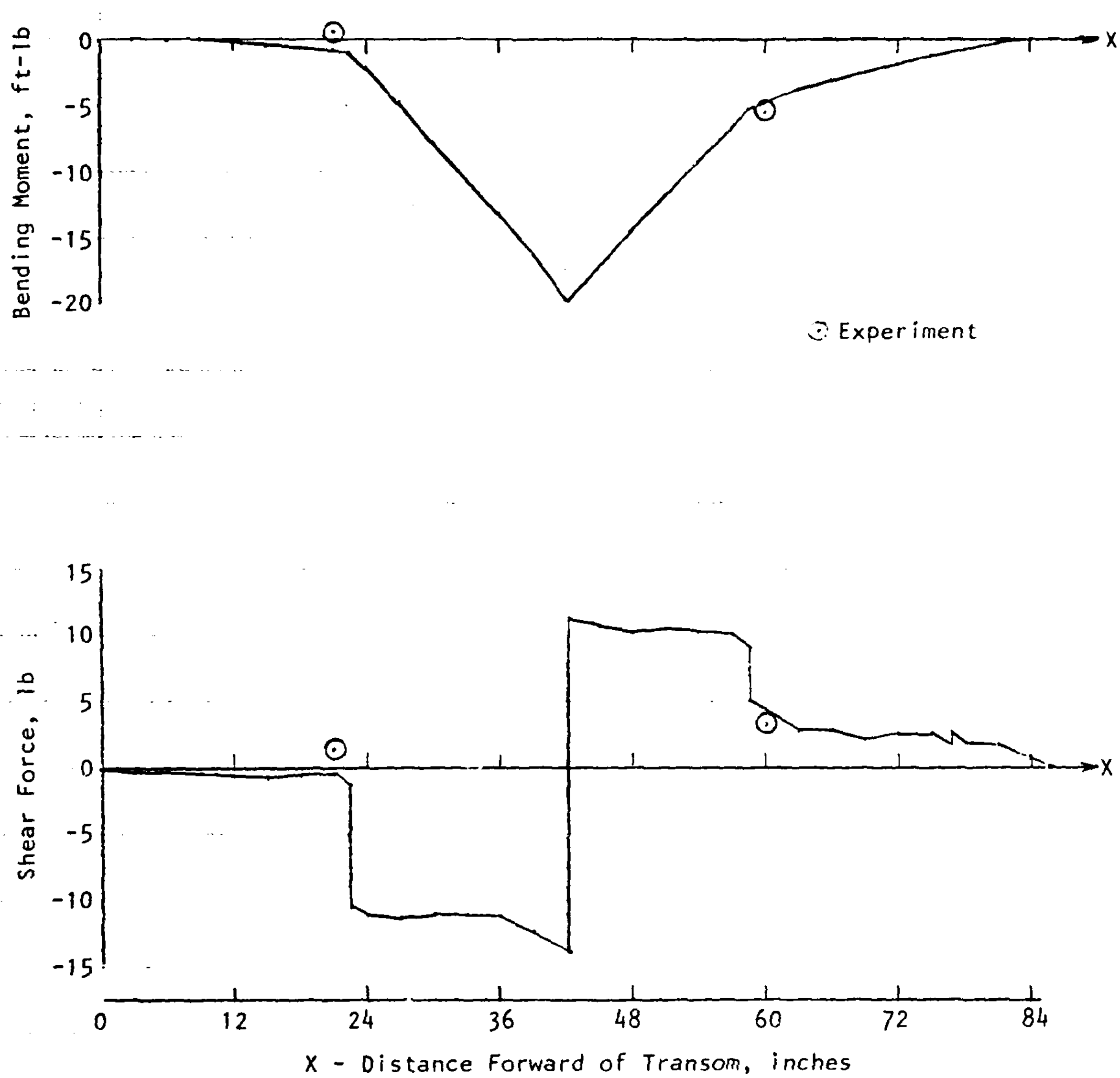

FIGURE 24 CALCULATED INSTANTANEOUS SHEAR FORCE AND BENDING MOMENT DIAGRAMS FOR RUN 262

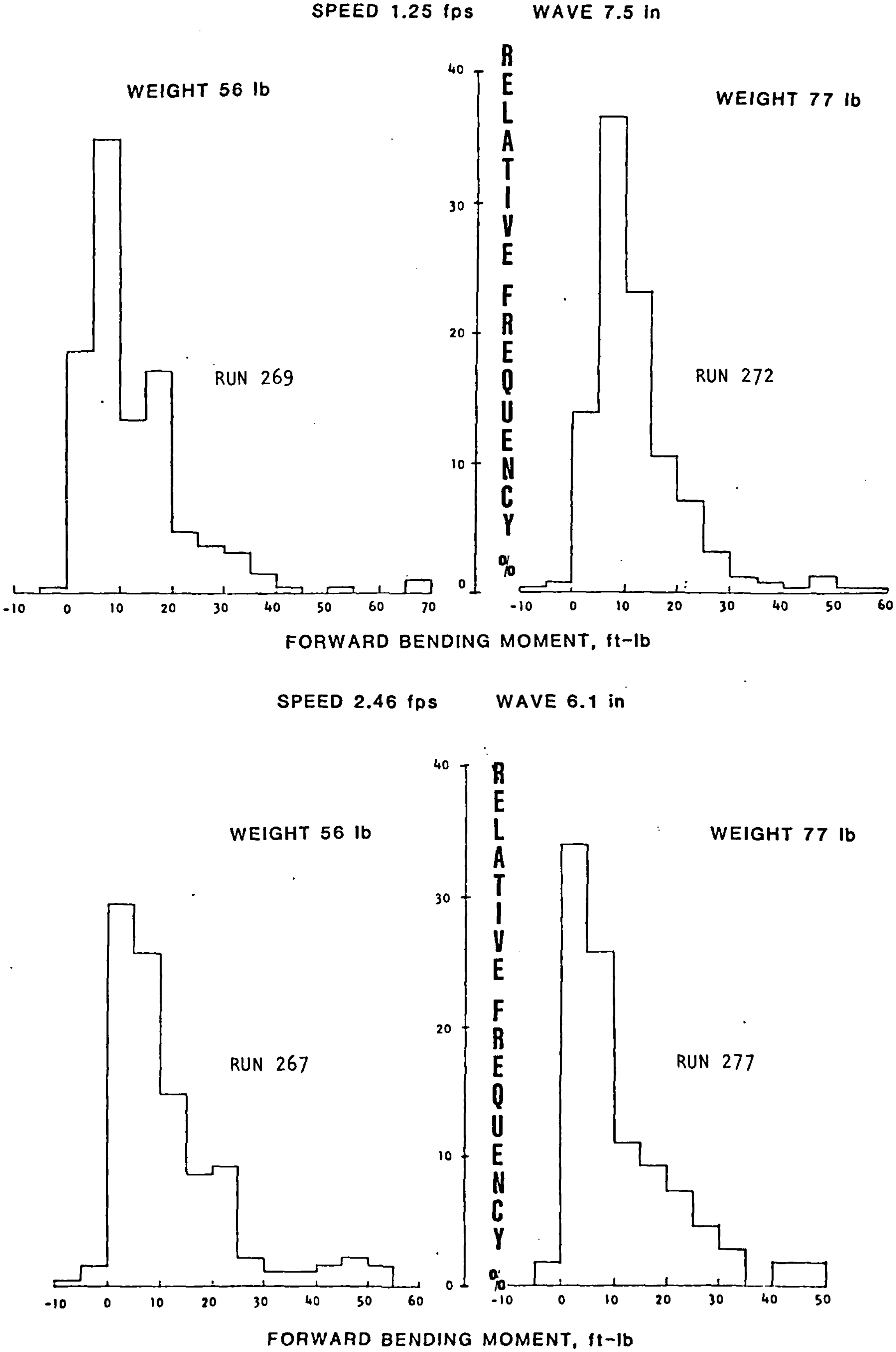

FIGURE 25 EXPERIMENTAL DISTRIBUTION OF PEAK BENDING MOMENT AT FORWARD CUT

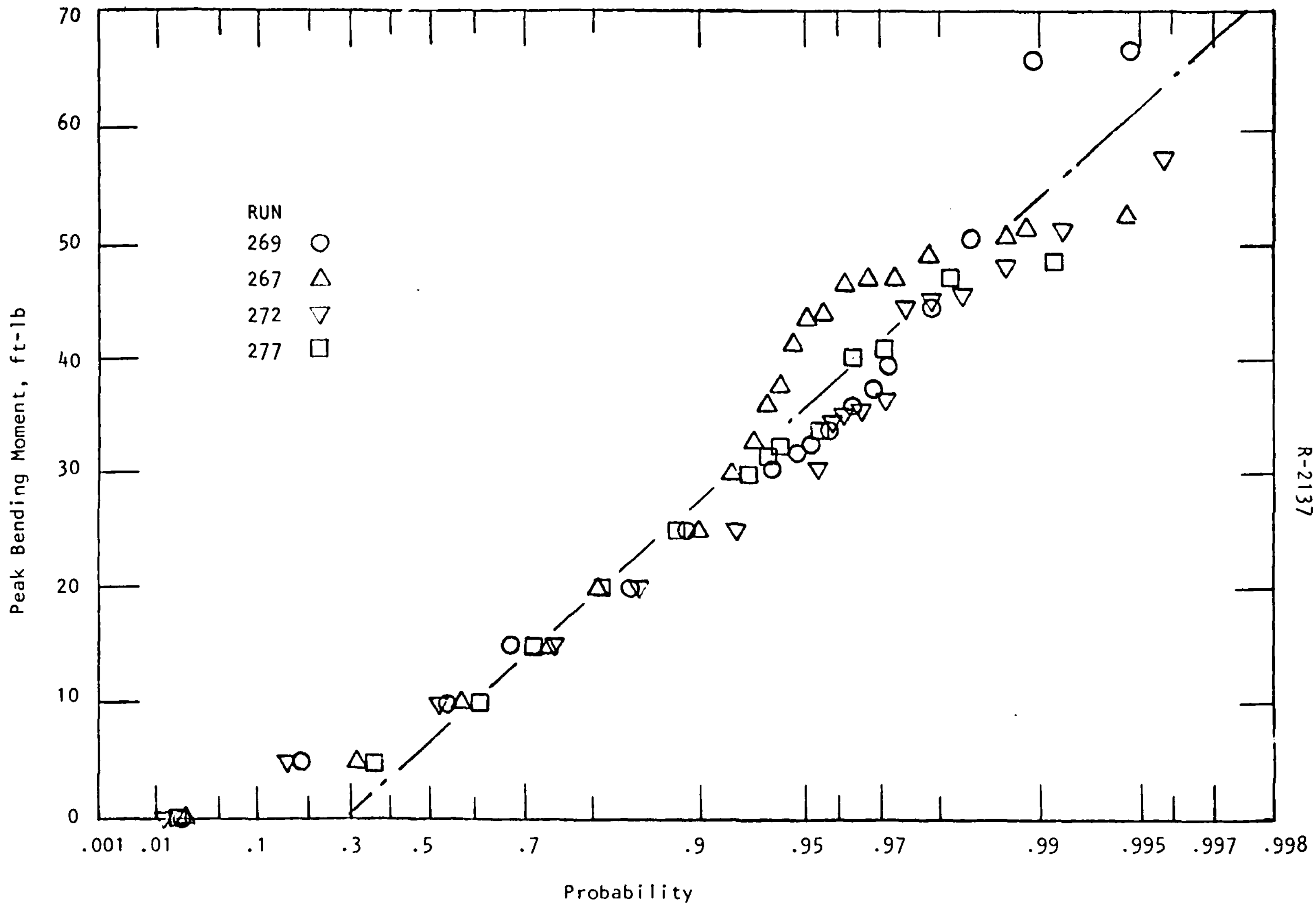

FIGURE 26 PROBABILITY DISTRIBUTION FOR PEAK BENDING MOMENT AT FORWARD CUT

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